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A clinical trial comparing the McKenzie method and a complex rehabilitation program in patients with cervical derangement syndrome

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Summary

Aim: The aim of the study was to compare the McKenzie method and a complex rehabilitation program called traditional therapy in patients with cervical derangement syndrome.

Material and methods: 61 patients aged 30-60 years with cervical derangement syndrome were included in the study. The patients were allocated to one of two, three-week interventions: the McKenzie method (30 subjects) and a complex rehabilitation program called traditional therapy (31 subjects). The variables such as centralization of symptoms, overall, head, neck, shoulders and upper extremities pain intensity as well as headache were assessed at entry and the end of the study. Number of pain-free days was recorded only after the rehabilitation.

Results: The McKenzie method was more efficacious than the complex rehabilitation program in regard to centralization of symptoms, overall, head and upper extremities pain intensity, headache and number of pain-free days. There were no differences between the interventions in neck and shoulders pain intensity.

Conclusions: 1) The McKenzie method seems to be more efficacious than traditional therapy in regard to centralization of symptoms, overall, head and upper extremities pain intensity, headache and number of pain-free days in treating patients with cervical derangement syndrome. 2) The movement which centralizes symptoms is more effective than a complex rehabilitation program.

Key words: cervical derangement syndrome, McKenzie method, centralization, pain intensity, headache, number of pain-free days

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INTRODUCTION

Neck pain is a commonly reported complain [1, 2]. It can result from many causes [3]. In many cases the cervical disorder has no specific, identifiable cause so it is diagnosed as a mechanical problem [4].

For the reason that the pathology of the neck problems is not fully understood there are various therapies often based on symptomatic signs. Despite the great variety of the treatment methods available there appears to be little scientific evidence of effectiveness of the therapies [5, 6, 7, 8]. Due to the limited number of the researches it is difficult to draw any conclusion about the treatment efficacy in the cervical disorders.

In Poland there has been an increasing interest in treating patients with cervical disorders with the McKenzie method. The method is a diagnostic and treatment modality for mechanical problems of the spine and extremities. The diagnosis of the McKenzie method enables to differentiate mechanical from non-mechanical cervical problems. It also allows to classified the mechanical disorders as one of the following syndromes: postural, dysfunction and derangement [9]. The classification may be reliable when the McKenzie assessment is performed by persons trained in the McKenzie method [10]. The diagnosis consists of a comprehensive history taking and a mechanical evaluation in which an assessment of the effect of repetitive movements and/or static positioning on the patient's symptoms is the key point. The most important response of the pain is centralization, when patient's referred or radiating symptoms from the spine move from the most distal position towards the cervical midline. Its occurrence indicates that the problem is mechanical [9]. The centralization phenomenon plays an important role both in the examination and treatment of the cervical problems. During examination it predicts successful treatment outcomes [9, 11] as well as helps to identify direction of treatment procedure called "directional preference" [9, 12]. Throughout a treatment period the phenomenon should progress until all symptoms are eliminated [9, 11]. There is insufficient evidence regarding the centralization in cervical disorders [13]. The centralization of symptoms of the cervical spine occurs only in derangement syndromes [9]. According to the previously McKenzie classification there are seven sub-syndromes of the derangements of the cervical spine but only the derangement 5 and 6 include symptoms radiating below the elbow [14]. There is little scientific evidence on the efficacy of the McKenzie method in cervical disorders [15, 16].

In Poland in many outpatient clinics patients with neck pain and radiculopathy are treated with a complex rehabilitation program called traditional therapy. The therapy consists of physical modalities, massage and exercises of the cervical and shoulders muscles. In many cases the patients are provided with analgesics as well as cervical collar and traction of the cervical spine.

The aim of the current study was to compare the efficacy of the McKenzie method with a complex reha-

bilitation program in patients with chronic cervical disorders classified to derangement five according to the diagnosis and previous classification of the McKenzie method. The outcomes included centralization of symptoms, overall, head, neck, shoulders and upper extremities pain intensity, headache as well as number of pain-free days (liczba dni bezobjawowych).

MATERIAL AND METHODS

The study sample was recruited from Out-Patient Unit of Rehabilitation in Łędziny and Ustroń from October 2002 to December 2003. 61 patients (22 women, 8 men in the M group, 25 women and 6 men in the T group) were allocated to one of two intervention groups. Patients in the M group (30 subjects) were treated with the McKenzie method and in the T group (31 subjects) with a complex rehabilitation program called traditional therapy. In the intervention groups the treatment period was limited to three weeks. Patients attended therapeutic sessions every two days.

Treatment in the McKenzie approach is based on a patient clinical presentation. In the method patient receives an individualized treatment plan which includes suited type of treatment procedures, number of treatment sessions and home exercises. Additionally, he receives a clear explanation of the mechanism that produces his pain. He is also educated about the need for maintenance correct postures and performance of daily living activities properly as well as avoidance of the activities that worsen his condition. In the McKenzie method the treatment procedures include individualized self-generated movements and static positions, although for patients with more difficult problems hands-on techniques can be provided. The therapeutic procedures are based on a directional preference identified during repeated test movement when a specific movement direction offers a beneficial response like centralization or symptoms abolishment. The goal of the method is to centralize and eliminate all symptoms, restore function and minimize the number of recurrence of episodes [9].

In our study subjects were treated according to the rules of the McKenzie method.

A complex rehabilitation program called traditional therapy was a combination of ultra-red irradiation, massage and exercises. They are commonly used in the management of cervical problems in Poland.

Ultra-red irradiation was applied bilaterally to the neck and shoulder area. It was conducted with a Sollux Lamp of AstarABR firm.

Each patient was treated with conventional massage. Spinal mobilization, manipulation and non-conventional techniques were not performed.

The exercises were aimed at the neck and shoulder muscles and included:

a) isometric contractions of each neck muscle group against resistance applied manually by a physiotherapist. Each maximal isometric contraction was held for

- 5 seconds followed by a rest for approximately 10 seconds,
- active self-assisted exercises for shoulder's muscles performed in the sagittal plane (flexion) and frontal one (abduction),
 - active exercises for shoulder's muscles performed in the transversal plane in non-weight bearing position,
 - additionally all patients were instructed in the use of home exercise program containing a maximal isometric contractions against resistance of all neck muscle groups held for 5 seconds followed by a rest for approximately 10 seconds. The resistance was applied by a patient.

All patients who agreed to participate in the study were given information regarding the study and its goals. They were allocated to the intervention groups on the basis of the following inclusion criteria:

- age 30-60,
- cervical mechanical syndrome classified as the derangement five according to the previously classification of the McKenzie method [14],
- chronic symptoms (lasted for at least 8 weeks according to the QTF classification) [17],

- occurrence of centralization phenomenon during an initial examination.

The participants were excluded if they:

- had pain due to disorders of upper extremities and thoracic spine,
- had history of surgery or injury to the head, spine or upper extremities,
- had instability of the cervical spine,
- had severe bone weakening diseases such as osteoporosis, advanced osteomalacia, Paget's disease,
- had severe coexisting diseases such as neurological, rheumatic, vascular, malignancies, advanced diabetes, cardiac and kidney failure, and mental disorders,
- were pregnant,
- took part in the study unsystematically,
- received other forms of therapy for cervical pain during the period of the study.

Our study included subjective and objective variables although only results of the following measurements are presented in this article:

- background data such as age, gender, height, weight,
- centralization phenomenon – the most distal symptoms were recorded on pain drawings [11, 18, 19],

Tab. 1. Characteristic of subjects in the M and T group at entry

Categories	M group	T group	Between groups effects
Number of patients	30	31	p=0,898
Age (years)	46,67 ± 7,91	49,03 ± 8,77	p=0,274
Gender: (% female)	73,33	80,65	p=0,497
Height (cm)	166,83 ± 6,94	165,26 ± 7,34	P=0,393
Weight (kg)	74 ± 12,86	74,60 ± 12,19	p=0,853
Chronic symptoms (%)	100	100	-
Localization of the most distal symptoms below the elbow (%)	100	100	-
Headache %	80	83,87	p=0,694
Intensity of pain score (0-100 mm scale)			
Overall	59,60 ± 12,68	63,84 ± 13,07	p=0,204
Head	38,00 ± 26,40	39,13 ± 31,47	p=0,881
Neck	52,59 ± 23,50	60,77 ± 21,76	p=0,166
Shoulders	34,76 ± 32,17	47,10 ± 30,58	p=0,133
Upper extremities	58,17 ± 17,72	65,10 ± 19,04	p=0,151

Note: Values are means and standard deviations unless otherwise stated.

Tab. 2. Frequency of the most distal symptoms in each parts of the body** before and after the treatment period (Rozkład częstości występowania objawów w poszczególnych częściach ciała przed leczeniem oraz po jego zakończeniu w obu rodzajach terapii)

Measurement	Localization of the most distal symptoms	Treatment groups				Total		**Localization of the most distal symptoms: 0 – no symptoms 1 – symptoms in the centre of the cervical and upper thoracic spine 2 – symptoms close to the cervical and upper thoracic spine and headache 3 – symptoms in the shoulders 4 – symptoms in the arm 5 – symptoms in the forearm 6 – symptoms in the palm
		M group		T group		N	%	
		N*	%	N*	%			
At entry	6**	30	100,00	31	100,00	61	100,00	
At the end of the treatment	0**	18	60,00	0	0,00	18	29,51	
	1**	6	20,00	0	0,00	6	9,84	
	2**	3	10,00	0	0,00	3	4,92	
	3**	1	3,33	2	6,45	3	4,92	
	6**	2	6,67	29	93,55	31	50,82	

*N – number of patients

- c) average pain intensity experienced by patients at each of the following sites: head, neck, shoulders and arms as well as overall using 100 mm Visual Analog Scale – VAS [20],
- d) headache,
- e) number of pain-free days.

Background data were registered during taking the history at entry. Localization of the most distal symptoms, pain intensity, headache were recorded at baseline and at the end of the treatment period. Number of pain-free days was assessed only on the 21st day of the treatment period.

Analysis of variance (ANOVA) with interactions was used to detect differences between changes achieved in the intervention groups (in regard to continuous variables). Results of categorical variables such as pain drawings, headaches were shown as distributions (number of subjects and percentages). Changes within the groups (between the pretest and posttest in each treatment group) in the continuous variables were tested by simple main effects. Number of pain-free days were calculated using Test U Manna-Whitney as the variable showed considerable departures from normality. Additionally, to

test significant differences between both treatment groups in regard to values of background and pretest data we used Student t tests for the continuous variables and χ^2 tests for the categorical ones. Means and standard deviations were calculated for all continuous variables.

RESULTS

Sixty-one patients were included in the trial. Characteristics of the patients are presented in Table 1. No significant differences were found between the two groups for all variables at entry.

Before the treatment period all patients in the M and T groups reported symptoms originating from the cervical spine and radiating below the elbow (according to one of the inclusion criteria). After the treatment in the M group 60% patients had complete centralization of symptoms, 20% reported central pain and 10% pain close to the cervical and upper thoracic spine and headache. 3,33% participants had symptoms radiating to the shoulder. Only 6,67% sufferers showed no change in the location of symptoms. In T group no patient had complete elimination of symptoms. 6,45% participants suffered from pain extended to the shoulder and 93,55% had still symptoms below the elbow (Table 2). As the data

Tab. 3. Changes within the groups in regard to overall, head, neck, shoulders and upper extremities pain intensity

Treatment groups	Pain intensity					
		Overall	Head	Neck	Shoulders	Upper extremities
M group	F p	F(1,49)=206,88 p<0,001	F(1,49)=38,35 p<0,001	F(1,49)=103,39 p<0,001	F(1,49)=29,80 p<0,001	F(1,49)=179,42 p<0,001
T group	F p	F(1,49)=15,95 p<0,001	F(1,49)=1,40 p<0,24	F(1,49)=40,23 p<0,001	F(1,49)=7,98 p=0,006	F(1,49)=23,88 p<0,001

Tab. 4. Analysis of variance with interactions (Anova) in regard to overall, head, neck, shoulders and upper extremities pain intensity (differences between interventions, changes, interactions between interventions and changes)

Pain intensity		Differences between the interventions	A change	Interaction between the interventions and the change
Overall	F(3,147) P	39,46 p<0,001	68,34 p<0,001	15,14 p<0,001
Head	F(3,144) P	16,56 p<0,001	20,92 p<0,001	6,61 p<0,001
Neck	F(3,144) P	9,96 p=0,003	50,82 p<0,001	1,94 p=0,125
Shoulder	F(3,144) P	36,09 p=0,000	25,09 p=0,000	2,13 p=0,099
Upper extremities	F(3,141) P	99,52 p<0,001	83,06 p<0,001	13,82 p<0,001

Tab. 5. Frequency of headache before and after the treatment in both intervention groups

Measurement	Headache				Total	
	M group		T group		N	%
	N*	%	N*	%		
At entry	24	80,00	26	83,87	50	81,97
At the end of the study	1	3,33	16	51,61	17	27,87

*N – number of patients

were categorical and the statistics consisted mainly of analyzing percentages it was impossible to use analysis of variance (ANOVA) with interactions to detect differences between changes achieved in the intervention groups. Nevertheless, these results appears to be convincing.

Before the intervention the mean values of overall and head, neck, shoulders and upper extremities pain intensity of both groups didn't differ significantly (Table 1). After the treatment in the M group there was a statistical significant decrease in the overall, head, neck, shoulders and upper extremities pain intensity. In the T group the significant improvements were reported for the overall, neck, shoulders and upper extremities pain intensity (Table 3). Analysis of variance with interactions (ANOVA) revealed that the improvements for the overall, head and upper extremities pain intensity were significantly grater in the M group compared with the T group. Concerning the neck and shoulders no significant differences in reduction of pain were found between the groups (Table 4).

At the beginning of the study 80% of participants in the M group and 83,87 % in the T group suffered from headache. In the M group at the end of the study there were only 3,33% of the patients who still had the problem. In the T group the tendency seemed to be incomparably weaker because 51, 61% subjects still had a headache after the treatment period (Table 5). As the data were categorical and the statistics consisted mainly of analyzing percentages it was impossible to use analysis of variance (ANOVA) with interactions to detect differences between changes achieved in the intervention groups.

Additionally, after the treatment number of pain-free days was observed. On the ground of the received results it was shown that in the M group 60% of participants achieved minimum 3 or more days without any symptoms. In the T group no patients had pain-free days (Table 6).

DISCUSSION

The primary finding of the trial is that the McKenzie method was more effective than the traditional therapy

in regard to most of the studied variables in patients with cervical derangement syndrome.

The centralization phenomenon was one of the analyzed variables in the investigation. The location of symptoms was documenting using a clear overlay template. The template and a scoring system has been used previously [11, 18, 19] and the inter-rater reliability for therapists to code the location of the most distal symptoms on the body diagram has been tested [18]. Occurrence of the centralization of symptoms in repeated end-range cervical test movement during initial evaluation was one of the main inclusions criteria in the trial. Although, according to Werneke et al. [11], a multiple-visit classification procedure is more precise for discriminating outcomes than the first-visit classification, patients who demonstrate centralization of symptoms during an initial mechanical assessment should have successful treatment outcomes. In this connection we use occurrence of the phenomenon during initial examination as a main inclusion criteria in order to recruit a homogeneous study sample of patients with cervical derangement syndrome. Analyzing changes in the location of symptoms in the M group at the end of the study a tangible tendency towards improvement was observed lying in the fact that there were many participants with elimination of the most distal symptoms (Table 2). The outcomes also revealed that a great number of patients did not suffer from headache (Table 5). In the T group this tendency seemed to be incomparably weaker (Table 2). McKenzie stated that relocation of the most distal symptoms in a proximal or central direction is evidence of good treatment outcomes [9]. Werneke et al. [18] observed that among patients with acute neck and low back pain treated with the McKenzie method those belonged to "the centralization" and "the partial reduction" group achieved grater improvement in regard to intensity of pain and perceived function contrary to "the noncentralization" group. According to this and on the ground of the received outcomes it seems that the McKenzie method was much more effective than the traditional therapy in the management of patients with cervical derangement syndrome. Similar results were obtain in two other studies in which more rapid elimi-

Tab. 6. Frequency of number of pain-free days achieved after the treatment in both intervention groups

Number of pain-free days	Treatment groups				Total	
	M group		T group		N	%
	N*	%	N*	%		
0	12	40,00	31	100,00	43	70,49
3	4	13,33	0	0,00	4	6,56
4	3	10,00	0	0,00	3	4,92
5	2	6,67	0	0,00	2	3,28
6	1	3,33	0	0,00	1	1,64
7	4	13,33	0	0,00	4	6,56
8	2	6,67	0	0,00	2	3,28
10	2	6,67	0	0,00	2	3,28
Total	30	100,00	31	100,00	61	100,00

*N – number of patients

Test U Manna-Whitneya: $U = 186,00$, $Z = 4,03$, $p < 0,001$

nation of the most distal symptoms was observed after the McKenzie treatment compared to traditional therapy [21] and traction of the cervical spine [22].

In the current study subjective magnitude of pain intensity of four parts of the body (head, neck, shoulders, upper extremities) and overall using the VAS was analyzed. The observed improvements for overall, head, and upper extremities pain intensity were significantly greater in the M group compared with T group. Concerning the neck and shoulders no significant differences in reduction of pain were found between the groups (Table 4). It is difficult to explain the lack of higher reduction of the neck and shoulder pain in the M group compared to the T one. The differences might lie on achieving centralized symptoms in much more patients in the M group than in the T group at the end of the treatment. According to the McKenzie method [9] the centralization of symptoms may be connected with appearance of pain of higher intensity adjacent to or in the centre of the spine. It is also unclear how the lack of centralization in so many subjects in the T group influenced on the outcomes. There are no studies (to our knowledge) comparing the McKenzie method to other treatment interventions in regard to pain intensity at the sites of the body in patients with cervical radiculopathy. Abdulwahab and Sabbahi [23] observed an increase in pain intensity after 20 minutes of reading and a decrease after 20 repetitions of retraction in patients with cervical radiculopathy. In Kjellman and Oberg's [24] investigation it was founded on the ground of a three-group analysis that there were no statistical differences between the McKenzie, general exercise and control group concerning pain intensity in patients with cervical disorders. Analysis by two-group comparison indicated significantly greater improvement in the McKenzie group compared with the control one at 3-week and 6-month follow-up. Regarding investigations into whiplash injury, subjects treated with the McKenzie method achieved greater decrease of pain intensity in comparison to standard intervention both short- and long term [25, 26].

One of the aim of the McKenzie method is to achieve complete elimination of all symptoms. In this connection in the current study number of pain-free days achieved after the treatment period was additionally analyzed. On the ground of the received outcomes it was observed that in the McKenzie group 60% of the subjects had a 3-day or longer period without any symptoms at the end of the study. In the traditional therapy group there was no patient who had complete elimination of all symptoms (Table 6). Kjellman i Oberg [24] founded that there was a significant improvement and no statistical differences between the McKenzie, general exercises and control group with respect to pain frequency after the treatment period. Lisiński I Wielogórka [27] observed that many patients with cervical problems had pain-free days after 20 days of the McKenzie method treatment.

In this investigation changes in both treatment groups were observed only at short-term follow-up. In so short period the possibility of natural recovery should be considered. This investigation did not include a placebo group so it was difficult to estimate the influence of the natural recovery on the results. However, in consequence of the fact that the McKenzie method was more effective in regard to most of the analyzed variables, it seems that the observed improvements in the M group could not be only the result of time. Also the lack of long-term outcomes do not allow to make firm conclusions on the overall efficacy of the McKenzie method.

CONCLUSIONS

- 1) The McKenzie method seems to be more efficacious than traditional therapy in regard to centralization of symptoms, overall, head and upper extremities pain intensity, headache and number of pain-free days in treating patients with cervical derangement syndrome.
- 2) The movement which centralizes symptoms is more effective than a complex rehabilitation program.

References/Piśmiennictwo:

1. Cassou B, Derriennic F, Monfort C i wsp.: Chronic neck and shoulder pain, age, and working conditions: longitudinal results from a large random sample in France. *Occup Environ Med* 2002; 59: 537-44.
2. Rustoen T, Wahl AK, Hanestad BR i wsp.: Prevalence and characteristics of chronic pain in the general Norwegian population. *Eur J Pain* 2004; 8: 555-65.
3. Bogduk N: Neck pain: an update. *Aust Fam Physician* 1988; 17 :75-80.
4. Bogduk N: Neck pain. *Aust Fam Physician* 1984; 13: 26-30. [270(3)].
5. Philadelphia Panel evidence-based clinical practice guidelines on selected rehabilitation interventions for neck pain. *Phys Ther* 2001; 81: 1701-17.
6. Karjalainen K, Malmivaara A, van Tulder M i wsp.: Multidisciplinary biopsychosocial rehabilitation for neck and shoulder pain among working age adults: a systematic review within the framework of the Cochrane Collaboration Back Review Group. *Spine* 2001; 26: 174-181.
7. Kjellman GV, Skargren EI, Oberg BE: A critical analysis of randomised clinical trials on neck pain and treatment efficacy. A review of the literature. *Scand J Rehabil Med* 1999; 31: 139-52.
8. Bronfort G, Haas M, Evans RL i wsp.: Efficacy of spinal manipulation and mobilization for low back pain and neck pain: a systematic review and best evidence synthesis. *Spine J* 2004; 4: 335-56.
9. McKenzie R, May S. *The Cervical and Thoracic Spine. Mechanical Diagnosis and Therapy. Vol. 1 I 2, Waikanae, New Zealand: Spinal Publications; 2006.*
10. Clare HA, Adams R, Maher CG: Reliability of McKenzie classification of patients with cervical or lumbar pain. *J Manipulative Physiol Ther* 2005; 28: 122-7.
11. Werneke M, Hart DL: Discriminant validity and relative precision for classifying patients with nonspecific neck and back pain by anatomic pain patterns. *Spine* 2003; 28: 161-6.
12. Hefford C: McKenzie classification of mechanical spinal pain: profile of syndromes and directions of preference. *Man Ther* 2008; 13: 75-81
13. Aina A, May S, Clare H: The centralization phenomenon of spinal symptoms - a systematic review. *Man Ther* 2004, 9: 134-43.
14. McKenzie R. *The Cervical and Thoracic spine. Mechanical Diagnosis and Therapy. Waikanae, New Zealand: Spinal Publications; 1990.*
15. Clare HA, Adams R, Maher CG: A systematic review of efficacy of McKenzie therapy for spinal pain. *Aust J Physiother* 2004; 50: 209-16.
16. Busanich BM, Verscheure SD: Does McKenzie therapy improve outcomes for back pain? *J Athl Train* 2006; 41: 117-9.
17. Spitzer WO: Scientific approach to the assessment and management of activity-related spinal disorders. A monograph for clinicians. Report of the Quebec Task Force on Spinal Disorders. *Spine* 1987; 12: S1-59.
18. Werneke M, Hart DL, Cook D: A descriptive study of the centralization phenomenon. A prospective analysis. *Spine* 1999; 24: 676-83.
19. Tuttle N: Do changes within a manual therapy treatment session predict between-session changes for patients with cervical spine pain. *Aust J Physiother* 2005; 51: 43-8.
20. Scott J, Huskisson EC: Graphic representation of pain. *Pain* 1976; 2: 175-84.
21. Olczak A: Ocena metody McKenzie w terapii pacjentów z chorobą dyskową szyjnego odcinka kręgosłupa. *Med Man* 2005; 1-2:27-32.
22. Olczak A, Janiszewski M: Porównanie szybkości ustępowania objawów choroby dyskowej szyjnego odcinka kręgosłupa leczonej metodą McKenzie oraz przy użyciu aparatu Saunders'a. *Med Man* 2004; 3-4:35-40.
23. Abdulwahab SS, Sabbahi M: Neck retractions, cervical root decompression, and radicular pain. *J Orthop Sports Phys Ther* 2000; 30: 4-9.
24. Kjellman G, Oberg B: A randomized clinical trial comparing general exercise, McKenzie treatment and a control group in patients with neck pain. *J Rehabil Med* 2002; 34: 183-90.
25. Rosenfeld M, Seferiadis A, Carlsson J i wsp.: Active intervention in patients with whiplash-associated disorders improves long-terms prognosis: a randomized controlled clinical trial. *Spine* 2003; 28: 2491-8.
26. Rosenfeld M, Gunnarsson R, Borenstein P: Early intervention in whiplash-associated disorders: a comparison of two treatment protocols. *Spine* 2000, 25: 1782-7.
27. Lisiński P, Wielogórka E: Estimation of twenty days treatment of neck pain by McKenzie method. *Chir Narzadów Ruchu Orthop Pol* 2005; 70: 217-21.