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PhD Thesis

Possibilities and limits of prevention of the restrictive ventilator dysfunction in ankylosing spondylitis by kinetotherapy contribution

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KEY WORDS
Ankylosing spondylitis
Pilates
McKenzie
Heckscher
INTRODUCTION

Ankylosing spondilitis (AS) includes a large spectrum of disorders of the loco motor system, articular and non-articular systems, with aetiology and pathogenic „original” mechanisms, with clinical manifestations and different evolutivity, with big dysfunctions generation potential, which also affects the respiratory function of the patient, leading to the installation of some forms of severe handicap.

After 1980, with this disease, medicine finds itself in one of its nodal points, with implications not also equally conceptual but also applied, out of which the practitioner, placed on the clinical realities field, can act coherently and most often successfully, and the fundamentalist theorist, subtle interpreter of the shades and meanings, allows himself to foresee new perspectives and even to risk generalisations of the type after which the rheumatology had so much to benefit from.

Ankylosing spondylitis treatment must be the work of the collaboration of many specialties, among which the kinetotherapy as well, in an associated effort which overlaps the prophylaxis tripod – treatment – rehabilitation.

CHAPTER V
MOTIVATION AND OBJECTIVES OF RESEARCH

Starting from the established idea in the specialty literature “like rachides is the same is the thorax”, within
the functional recovery of the ankylosing spondylitis, is given a special importance to keeping a correct posture and sustaining the mobility of the spinal column and of the joints of the ribcage, which will act together to the precise determination of the respiratory function in order to be prevented the installation of the restrictive ventilatory dysfunction.

As between the structure and the respiratory function is a close dependence, which is translated by the fact that a normal rest breathing, of a well balanced skeletal and muscular thorax, is executed through the own muscularity of thorax and of the diaphragm, in an active casing „limited” of the thorax’s form and position, I have decided to give a major importance to the training of influencing the mobility of costo-rachidian and costosternal articulations.

Among all the rheumatic disabiltant diseases, AS benefits from the majority of physical methods, although it is still not sure, which type of exercises are the most beneficial in order to prevent restrictive ventilatory dysfunction.

As many authors state like for example McKenzie, Pilates, Heckscher, we can intervene in deposturations and especially in the correction of vertebral static disorders, through techniques which maintain the body alignment, a good mobility and what is extremely important a correct breathing, preventing the disorders of pulmonary ventilation.

McKenzie, Pilates, Heckscher methods unlike the traditional programs in the medical rehabilitation of the patients with AS, make up a unique system, which contain exercises of articular stretching and muscular
toning, improving the posture, due to an awareness which establishes a “connection between the body and mind”. The traditional programs of therapeutical exercises had rather at their base the training of the individual on each muscle and each segment, than on the body training, which is considered - a whole.

We intervened on the body alignment of the patient with AS by applying McKenzie, Pilates, and Heckscher methods, because the therapeutical exercises do not singularize only certain muscles generating an unbalanced body, but they align the posture. The invigoration of the muscularity in a uniform way and keeping the physiological curves of the spinal column as long as possible, represents the key of a correct posture, which leads to maintaining the breathing compliance.

The unique element and a very important one of McKenzie, Pilates, and Heckscher exercises represents the fact that they can be practised anywhere, without using devices and that a single well executed movement values much more and damages less than twenty executed disorderly.

The optimum moment in AS treatment is the period of the first appearance of the disease, the period of pre-moulding of inflammatory entheses and changing into synostosis.

Provisioned with data about the clinical profile of AS and knowing that, in its evolution the disease leads to clinical invalidating forms, of kyphosis, of rectitude, of peripheral ankylosis, we lead ourselves to a kinetotherapeutic program through which we can stop
deformations and deposturations of the spinal column, delaying the ankylosis.

The present paper seeks that, based on the theoretical notions from the published literature and from the accumulated practice, to specify the role of Pilates, McKenzie and Heckscher methods in the functional recovery of the patient with AS regarding restrictive ventilatory dysfunction prevention.

Taking into consideration these reasons, the fundamental idea on which we base upon in the formulation of the objectives of this study (presenting the results in 77 tables, 143 figures and 226 bibliographical references), is that the main purpose of the patient’s management with AS, without vertebral radiological modifications, is ensuring the breathing normal function as long as possible.

The objectives of the research
1. Carrying out a screening of the patients with AS, with axial form, from the group of those diagnosed with diseases enclosed in the sphere of spondyloarthropathies (SpA), with prevalent affectation of the spinal column, hospitalized in the Rheumatology Clinic of the Rehabilitation Hospital from Iaşi, in the period 2008-2010, identifying: their epidemiologic characteristics; the number of carried out hospitalizations and the frequency of the hospitalizations of each patient; the way of their complying with the received medical recommendations (study A);
2. Carrying out a screening of the patients with AS found out in the radiological state of sacroiliitis, from the group of those diagnosed based on the criteria from New
York, hospitalized in the Rheumatology Clinic of the Rehabilitation Hospital from Iaşi, in the period 2008-2010, following the epidemiologic characteristics (study B);

3. Carrying out an observation study, of cohort, retrospective, carried out on a group of patients with AS, being in the radiological sacroiliitis stage, that were hospitalized in the Rheumatology Clinic of the Rehabilitation Hospital from Iaşi, in the period of 2008-2011, following the epidemiologic characteristics, the clinical – functional profile of the patient, and also the evolution of the disease under kinetic treatment carried out at the domicile (study C);

4. Carrying out a clinical experimental study, randomized in a controlled way, in the period 2009-2011, regarding the efficiency of Pilates, McKenzie and Heckscher methods in the stagnation of AS disease evolution and restrictive ventilatory dysfunction prevention, at the patients being in the radiological stage of sacroiliitis (study D).

CHAPTER VI
MATERIAL AND METHODS

6.1 Material

Study A

The study followed the carrying out of a screening of the patients with AS, with axial form (with typical start defined through low back pain and rachialgias at lombosacral level), from the group of those diagnosed with diseases enclosed in the SpA sphere with vertebral affectation (inflammatory specific spondilopathies and
non-specific with multiple localizations in the spinal column, AS with multiple localizations in the spinal column, non-classified sacroiliitis somewhere else), hospitalized in the Rheumatology Clinic of the Rehabilitation Hospital from Iași, in the period of 2008-2010, at whom there were noticed a few epidemiological aspects, regarding the following: the total number of carried out hospitalizations; the total number of hospitalized cases; the distribution of patients hospitalizations on sexes; the distribution of patients hospitalizations on the background of origin; the distribution of patients hospitalizations on age categories; the distributions of patients according to the number of carried out hospitalizations; the distribution of patients on age groups depending on the number of carried out hospitalizations.

**Study B**

The study followed the carrying out of a screening of the patients with AS, being in the radiological status of sacroiliitis, from the group of those diagnosed with based on New York criteria (1984), hospitalized at the Rheumatology Clinic of the Rehabilitation Hospital from Iași, in the period 2008-2010, at whom there were highlighted the epidemiological characteristics, regarding: the distribution of the patients on sexes; the distribution of the patients on age categories; the distribution of patients of the origin background; the average age of the disease in the radiological sacroiliitis stage; the distribution of the patients regarding the period of the disease; the distribution of the patients depending on the radiological stages of the sacroiliitis.
**Study C**

The retrospective cohort study was carried out on a group of 88 patients with AS, being in the radiological sacroiliitis stage (through the analysis of the medical records of them), that were hospitalized in the Rheumatologic Clinic of the Rehabilitation Hospital from Iași in the period of 2008-2011. The epidemiological characteristics were followed, and also a series of clinical and functional parameters which allowed the calculation of some initial scores during the first hospitalization (the first assessment) and final, during the second hospitalization (the 2nd assessment); measuring the parameters was carried out at a period of 6 months; on their base, the clinical – functional patient’s profile could be determined in this stage of the disease, and also the treatment’s efficiency that was carried out at the domicile.

The studied group of patients was recommended a kinetic treatment and medication (NSAIDs/biologics) after the methodology commonly used in the clinic, by the specialists group, doctors and kinetotherapists.

**Study D**

In the context of the approach of a clinical open randomized study, the efficiency of the methods Pilates, McKenzie and Heckscher was determined within the physiotherapy methodology, and their role in stagnating the disease evolution and prevention of restrictive ventilatory dysfunction, and also the increase of patients ‘life’s quality who were included in the study.

The assessments followed the demographic characteristics regarding: age, the period of the disease,
the distribution on sexes, and the radiological stage of sacroiliitis. ASAS parameters were followed (Assessments in Ankylosing Spondylitis) (1) whose value scales allowed the calculation of some scores, regarding the mobility of the spinal column, assessing the global back pain, disease activity, functional ability level and patient’s life’s quality with AS; the function of the respiratory system was evaluated by means of Spirometry, in accordance with the methodology of assessment used in the modern research, based on evidence.

This study has included 96 patients diagnosed with AS, in accordance with the modified criteria from New York (2). They were divided into 2 groups: the study group - 1 (48 AS), included in a multimodal program of Pilates, McKenzie and Heckscher exercises, carried out within “Ţopa Ionuţ” Rehabilitation Medical Cabinet - Iaşi and the control group - 2 (48 AS), which developed a multimodal traditional kinetic program, within The Clinical Rheumatology and Rehabilitation Hospital- Piatra Neamţ. The patients were trained regarding the beneficial therapy for their disease, they were asked not to use medication treatment specific to the disease, other than that stipulated in the study. They were determined to fill in a particular diary, each session of carried out exercises, and will subsequently present it at the end of study. A kinetotherapist provided the instructions and initially guided the training. After the learning style of the exercises was coached in the specialty clinic, in ambulatory regime for the period of 12 weeks (3 months), the kinetotherapy was carried out on an individualized way at home, including aerobic exercises,
of “resistive” type, for 50 minutes, with a frequency of the sessions of 3 times a week, on a period of 6, respectively 12 months.

The aerobic exercises were developed in the cardiac area of the training of reduced intensity, situated at a value of 50-70% from cardiac frequency (Fc) of standby (Fc of standby=Fc max-Fc of rest time). This was the area of “fundamental endurance”, in which it was developed 80% from the therapeutical program time (3, 4). The cardiac frequency of work or the cardiac rhythm of training was calculated after the formula: FcL = % (Fc max – Fc rest time) + Fc rest time

6.2 Criteria of the patients’ selection

- General criteria of inclusion in the study followed:
  - enclosing the patients in SpA sphere based on ASAS criteria; or
  - enclosing in AS diagnostic defined in accordance with the criteria from New York modified (1984);
  - Disease with axial start;
  - Patients who had kinetic program established at home;

6.3 Methods

Within D study, the patients of group 1 have followed a special kinetic program of 3 modules:

- “Heckscher Method”: analytical exercises addressed to the muscles of the involved segments in the respiratory act, following the preparation of the human body for effort (20 minutes);
• “Pilates Method”: breathing exercises, exercises for abdominal muscles, buttock muscles, paravertebral muscle, superficial trunk muscles, pelvic flexors in neutral position, progressive stretching of trunk, arms and legs muscles (20 minutes);
• “McKenzie Method”: exercises of specific postural reeducation, following the correction of the lumbar lordosis (10 minutes).

The Program of exercises applied to the patients of the control group, was adapted after the suggested program by Ince (5) and was divided into 3 modules following:

• The “Warm-up” period: analytical exercises (10 minutes + 5 minutes stretching exercises for the head, neck and scapulohumeral articulation);
• “Main period” for aerobic exercises (20 minutes);
• „Cool down” period: respiratory exercises (10 minutes + 5 minutes stretching exercises for the body and upper body and coxofemoral articulation).

6.4 Used methodology of assessment

The clinic – functional parameters estimated at the studied groups of patients were:

• Visual analogue scale of assessing the global pain - VAS is measured on a scale of 0-100 mm (0 = absence; 100 = severe), that corresponds as value with the intensity of the pain felt at lumbosacral level, in the last week (6, 7);
- **Ott index** which measures the mobility of the dorsal spinal column (over 3.5 cm = normal);
- **Schober index** which measures the lumbar spinal column mobility (over 5 cm = normal);
- “Finger-to-floor distance” – **DDS** (0 cm = normal); values with minus (-) low mobility of the spinal column; values with plus (+) very good mobility;
- **DIE** index (the difference between breathe in and breathe out) or chest expansion (over 5 cm = normal chest elasticity);
- **Vital Capacity** (VC<75% is considered as restrictive respiratory dysfunction);
- **BASDAI** (Bath Ankylosing Spondylitis Disease Activity Index), is measured on a scale from 0 – 10 (0 = absent; 10 = very severe) (8);
- **BASFI** (Bath Ankylosing Spondylitis Functional Index), is measured on a scale from 0 – 10 (0= maximum functional;10 = minimum functional) (9, 10);
- **BASMI** (Bath Ankylosing Spondylitis Metrology Index), is measured on a scale from 0 – 10 points (0 = normal mobility; 10 = very low mobility) (11-13);
- **HAQ – DI** (Health Assessment Questionnaire) index of life’s quality, whose total score varies between 30 – 0 points, was estimated in D study (30 = normal; 0 = severe) (14, 15);
- Drugs therapy, NSAIDs and/or biologics was assessed at every moment of the study, as a variable divided in two parts, “present” and “absent”;
• **ASAS 20% response criteria to treatment** and its measuring instruments (16-20), were applied, reading the assessment of the patient, for measuring the response to therapy and for monitoring the activity of the disease, the physical function and structural damages (table 1).

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
</table>
| ASAS 20% response criteria | ASAS20 | Treatment response is defined as:  
≥ 20% and ≥ 10mm VAS on a 0-100 scale in at least 3 of the 4 ASAS-IC domains, and  
No worsening of ≥20% and ≥ 10mm VAS on a 0-100 scale in the remaining 4th domain |

**6.5 Statistic significance of the obtained results**

In the cohort observation study, retrospectively it started from the already installed disease and there were highlighted the main factors, fact that led to defining a morpho-functional profile of the patient with AS. Undertaken randomized experimental study, controlled, was of case – control type. In the presentation of statistic data, confidence intervals were used at the significance threshold 95% (p<0.05). The statistic processing was realized with SPSS, version 17.00. Derivative indicators were used, highlighted through the test ANOVA which
consists of the dispersion’s analysis of the dependent variable compared to the independent one:

- indicators of the average value: the simple arithmetic mean, median, module;
- Indicators of dispersion: standard deviation, variation.

Chi-squared ($\chi^2$) test comparing two or more distributions of frequencies originated from the same population, it was applied when the expected events were excluded, assessing the qualitative differences between groups. By the calculation of the significant difference between two environments; Student $t$ - test took into consideration the measurement of the variability and the weight of observations.

**CHAPTER VII**
**RESULTS**

**7.1 Study A**

Study A highlighted the frequency of patients hospitalizations diagnosed with AS, with axial form, by carrying out a screening, bearing in mind the estimation of the way of respecting by them the received medical recommendations, within the Rheumatology Clinic from Iași in the period of 2008-2010, and also their epidemiologic characteristics.

In this period there were registered a number of 737 (90,98%) of hospitalization, or of those 819 (100%), for the inflammatory disease predominantly axial, the analysis found 393 of cases that were present at the specific medical check-up.
From the epidemiologic characteristics point of view, the following aspects were observed: the prevalence of male sex (76.93%); the prevalence of the patients from the rural areas (58.61%), but with a close percentage and of those from the urban areas (41.38%); the prevalence of the age categories 35-44 years (25.23%), followed by 45-54 years (24.55%); the prevalence of cases with one hospitalization (48.09%), remaining on the last place those with a frequency of 6 hospitalizations (1.52%).

Regarding the distribution of patients with AS on age groups depending on the number of hospitalizations in the period 2008-2010, it was noticed that the biggest frequency of cases was in the age categories of 45-54 years old (13.23%) at 1 hospitalization, followed by the age group of 35-44 years old at 2 hospitalizations (8.65%).

From the total of 393 (100%) of hospitalized patients, the majority were registered in the age group of 45-54 years old, representing 99 of cases (25.19%), and the majority of hospitalizations from those 737 were in the age group of 35-44 years old (25.23%), (table 2).

It was noticed that the patients AS, with axial form, presented a low frequency of the hospitalizations regarding carrying out the medical check-up, recommended twice a year; the prevalence of the case with 6 hospitalizations registering a very low percentage (4.88%); those being the age under 24 years old, being in the stage when the spinal column was not embraced by the ankylosing evolution given by the disease have shown an unsatisfactory frequency (8.39%).
Table 2 Distribution of patients with AS on age groups depending on the no. of hospitalizations
In the period 2008-2010

<table>
<thead>
<tr>
<th>Period 2008- 2010</th>
<th>Patients</th>
<th>Total of patients</th>
<th>Total of hospitalizations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>under 24 years</td>
<td>25-34 years</td>
<td>35-44 years</td>
</tr>
<tr>
<td>1 hospitalization</td>
<td>12 (3, 05%)</td>
<td>16 (4,06 %)</td>
<td>41 (10, 43%)</td>
</tr>
<tr>
<td>2 hospitalizations</td>
<td>10 (2, 54%)</td>
<td>26 (6,61 %)</td>
<td>34 (8,65 %)</td>
</tr>
<tr>
<td>3 hospitalizations</td>
<td>11 (2, 79%)</td>
<td>15 (3,81 %)</td>
<td>15 (3,81 %)</td>
</tr>
<tr>
<td>4 hospitalizations</td>
<td>0</td>
<td>3 (0,76 %)</td>
<td>4 (1,01 %)</td>
</tr>
<tr>
<td>5 hospitalizations</td>
<td>0</td>
<td>1 (0,25 %)</td>
<td>2 (0,50 %)</td>
</tr>
<tr>
<td>6 hospitalizations</td>
<td>0</td>
<td>1 (0,25 %)</td>
<td>1 (0,25 %)</td>
</tr>
<tr>
<td>Total of patients</td>
<td>33 (8, 39%)</td>
<td>62 (15, 77%)</td>
<td>97 (24, 68%)</td>
</tr>
<tr>
<td>Total of hospitalizations</td>
<td>65 (8, 81%)</td>
<td>136 (18, 45%)</td>
<td>186 (25, 23%)</td>
</tr>
</tbody>
</table>

7.2 Study B

Study B highlighted by carrying out a screening, the prevalence of patients with AS, being in the radiological stage of sacroiliitis, hospitalized in the Rheumatology Clinic of the Rehabilitation Hospital from Iaşi, in the period of 2008-2010, and also their epidemiologic characteristics.

From the total of 393 (100%) hospitalized patients with axial affectation, those being in the radiological
stage of sacroiliitis were 68 cases (17.30%), fact reflected in fig. 1.

Fig. 1 The percentage of patients with AS being in the radiological stage of sacroiliitis in the period of 2008-2010

The study confirmed the fact that AS appears at the young age, the average age being of approximately 25 years, predominantly at the male sex (86.76%) (M/F= 6.6/1);

As regarding the origin environment of the patients being in this stage of the disease start-up phase, the prevalence of the cases was at those that belonged to the urban environment, representing 39 cases (57.35%) (U/R=1, 3/1);

The age interval, with the greatest frequency of the patients, was included between 25-29 years old (47.05%), followed by the age interval of 20-24 years old (27.94%);

The duration of the patients disease with AS without radiologic vertebral modifications, has varied from 1 to 12 years, with an average value of 5.60 years;

The structure of the subjects group being in the radiologic sacroiliitis stage, has shown the prevalence of
the cases in the III stage of disease (at the feminine sex 55,6% and at the masculine sex 57,6%, at patients with ages of over 25 years 78%, at the patients originated from the urban environment 71,8% and from the rural one 37,9%), followed by the II stage of affectionation, at patients from the age category under 25 years (55,6%).

7.3. Study C

Regarding the initial clinic-functional profile of the patient with AS, in a phase in which the spinal column’s morphology is not affected and highlighting the efficiency of the kinetic treatment carried out at home, a series of results were noticed, that deal with the parameters specific for the disease. Analysing the epidemiologic characteristics of the studied group, regarding the distribution on sexes, prevalent was the male sex (88,6%), and the distribution on origins of environments belonged to the urban environment (60,2%). The most affected age interval was of 20-24 years (45,5%), the average age of the patients was of 25 years, and the average value regarding the period of the disease of 6,15 years; patients distribution on radiologic stages of the sacroiliitis has highlighted the prevalence of the stage III (40% at the female sex and 29,5% at the male sex; 42,2% at patients with ages over 25 years; 32,1% at the patients originated from the urban environment and 28,6% at those originated from the rural one), fact reflected in the table 3.
Table 3. Initial clinic-functional profile of the patient with AS in sacroiliitis radiological stage

<table>
<thead>
<tr>
<th>Initial profile</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td>Male</td>
</tr>
<tr>
<td>Age (years)</td>
<td>25,00±3,93 ani</td>
</tr>
<tr>
<td>Origin environment</td>
<td>Urban</td>
</tr>
<tr>
<td>Disease age (years)</td>
<td>6,15±3,03 ani</td>
</tr>
<tr>
<td>Radiological stage</td>
<td>III</td>
</tr>
<tr>
<td>VAS (score)</td>
<td>Moderate = 54,55</td>
</tr>
<tr>
<td>DDS (cm)</td>
<td>-18,90 ± 8,18</td>
</tr>
<tr>
<td>Schober (cm)</td>
<td>2,66 ± 0,79</td>
</tr>
<tr>
<td>Ott (cm)</td>
<td>2,42 ± 0,84</td>
</tr>
<tr>
<td>DIE (cm)</td>
<td>3,30 ± 0,84</td>
</tr>
<tr>
<td>VC (%)</td>
<td>101,29 ± 11,51</td>
</tr>
<tr>
<td>BASDAI (score)</td>
<td>5,20 ± 1,71</td>
</tr>
<tr>
<td>BASFI (score)</td>
<td>3,73 ± 2,15</td>
</tr>
<tr>
<td>BASMI (score)</td>
<td>3,03 ± 1,11</td>
</tr>
</tbody>
</table>

By the qualitative and quantitative assessment of the morpho-functional system, complex data were delivered regarding the following parameters:

1. Regarding the installed pain with inflammatory character was present in a moderate way (with an average value of 54,55) and has reduced from intensity after 6 months up to easy perception (38,52), ameliorated with 30% (p=0,001).

2. The dorsolumbar spinal column’s mobility has registered, both at the first and at the second assessment limited movements. The specific tests did not reach satisfactory values after 6 months of treatment (DDS = 16,80 cm; Schober = 2,98 cm; Ott = 2,79 cm).
3. The mobility of small articulations of the chest could be appreciated in both moments of assessment, by measuring the chest expansion (initially DIE = 3,30 cm); the average values did not reach normality, even though radiologic vertebral modifications did not install; it was significantly improved from the statistic point of view at the 2nd assessment with 12,7%, reaching an average value of 3,72 cm (p<0,002).

4. The assessment of the respiratory function characteristic to the restrictive syndrome was applied in order to calculate the kinetotherapy effects on the respiratory system. In those two assessment moments, VC has registered average values that were considered as being normal (VC>75%), respectively 101,29% and 103,82% (p>0,05).

5. The average scores BASDAI, BASFI, BASMI, after the treatment have shown values considered as being at a „functional” level, regarding the spinal column’s flexibility, the fatigue and „disability” (BASDAI=3,89 p<0,001; BASFI=2,77 p<0,002; BASMI=2,66 p<0,05).

6. Presenting the patient’s profile regarding pharmacotherapy, after the first assessment it was registered a drug therapy of NSAIDs, which was administered predominantly to patients of male sex (47,7%), but the frequency distribution on sexes was not significant from the statistic point of view, in comparison with patients (males 40,9%) who did not receive NSAIDs (p>0,05); treatment administering of NSAIDs was predominant at patients with ages above 25 years (38,6%), in comparison with those under 25 years (13,6%) (p<0,001)
7. As regarding the measuring response ASAS20 to treatment, after 6 months, a proportion of 30.7% patients was noticed who responded to therapy established at hospitalization and continue at home (fig. 2), existing a prevalence of those from the age group of under 25 years (46.5% vs 15.6%) (p=0.004); the other characteristics (sexes, origins) did not highlight significant statistics differences (p>0.05).

![Assessment at 6 months](image)

**Fig. 2** The distribution of respondent subjects from the study group

The obtained values, statistically processed (ANOVA Test, t-Student test, $\chi^2$ test, the variation coefficient) have proved the usefulness of the traditional programs of kinetotherapy, suggesting also the idea of a new action, through the approaching, constitution and monitoring of a new group, to which it can apply, in the therapeutic complex, a modern methodology of more important functional support of the spinal column.
7.4 Study D

The functional rehabilitation of the patient with AS represents an essential concern for the rehabilitation team, being necessary targeted indications and well selected techniques.

The study aims as an objective, precisely this perspective bringing into consideration the support of modern methodology, Pilates, McKenzie and Heckscher in preventing restrictive ventilatory dysfunction in AS.

In the created conditions, by making the two groups of subjects with AS, comparable as structure (sex, average age and age groups, environmental origin and radiologic stage of sacroiliitis), the comparative analysis of the results is used for proving the methods efficiency - Pilates, McKenzie and Heckscher (21-47), within the methodology of recuperative treatment, applied to the group of study, while at the witness group traditional kinetic treatment was carried out of AS (5).

1. The assessment of the global spinal pain under the beneficial effects of the kinetotherapy, has shown that the index VAS was significantly improved at both groups (with 62,9% vs 39,5%), reaching an average score of slight pain perception (10-30 VAS); after a year of treatment, the pain’s intensity was bigger (21,04) at the group treated with traditional kinetic methods, in comparison with the study group (13,54) (p<0,001), (fig. 3);

2. Underlying the main role of kinetotherapy in AS, of preventing the loss of the spinal column mobility, it was noticed that the instituted therapy at home ensured that together with the appropriate increase of muscular tonus and a muscular-articular stretching. Specific
indices: DDS, Ott, Schober were improved at both studied groups, at 6 and 12 months, but at the end there were registered significant statistic differences between the groups, in favor of group 1, those who carried out the exercises of Pilates, McKenzie and Heckscher’s methods (p<0,001) (fig. 4-6).

Fig. 3. Average values at the 3 assessments of the score of assessment of the pain on VAS scale On study groups

Fig. 4. Average values of DDS index on study groups at the 3 assessments

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3. The awareness of the respiratory act and the correction of axial curvatures, have contributed to the growth of the freedom degree of the movements, influencing the posture and improving the pulmonary function. DIE index: at 6 months, the average score of chest expansion was improved at group 1 from 3,94 cm to 5,10 cm, improved with 29,4% (p=0,001), respectively
5.88 cm (49.2%) at 12 months (p=0.001); at group 2, this index has increased from 3.86 to 4.35 at 6 months, improved with 12.7% (p=0.052) and only 4.39 cm (13.7%) at 12 months (p=0.002). Among the studied groups there were registered statistically significant differences, the average values have increased especially at patients treated with modern kinetic methods (p<0.001) (fig. 7).

![Graph showing DIE index on groups 1 and 2 at 3 assessments](attachment:image.png)

**Fig. 7.** Average values of DIE index on the groups of study at the 3 assessments

VC: average values were not changed at 12 months of treatment, in comparison with the 1st assessment (group 1, p=0.124; group 2, p=0.997), but there were significant differences among the groups (p=0.011). VC has increased at group 1, from 99.50% initially to 105.63% at the end of the study, and at group 2, from 101.80% has slightly decreased at 101.31% at 12 months of treatment (p>0.05) (fig. 8).
4. There were influenced the multiple facets of the process from AS, such as: BASDAI index: at 6 months the average score has decreased from 5,41 to 3,38, improved with 37,5% (p=0,001), respectively 2,10 (61,2%) at 12 months of kinetic treatment at group 1 (p=0,001); at group 2 from 5,29 to 4,14 at 6 months, improved with 21,7% (p=0,015) and at 12 months to 4,13, improved with 21,9% (p=0,002). Among the studied groups, significant differences were registered, the average values have decreased, especially at group 1 (at 6 months p=0,041; at 12 months p<0,001) (fig. 9).
BASFI index: at the 2nd assessment it was highlighted the decrease of the average functional score from 3.56 to 2.62 at 6 months, improved with 26.4% (p=0.001), respectively 1.50, improved with 57.9% at 12 months, at group 1 (p=0.001); at group 2 from 3.42 to 2.71 at 6 months, improved with 20.8% (p=0.014), slightly increasing to 2.76, improved with 19.3% at 12 months (p=0.041). At the end of the study, the physical function registered significant statistic differences of the average values among the analyzed groups, in favour of the group treated with modern kinetic methods (p<0.001) (fig. 10).

Fig. 10. The average values of BASFI score on the groups of study at the 3 assessments

BASMI index: at 6 months from the training of the modern kinetic treatment, the average score of the metrological index of AS decreased, from 3.73 to 2.19, improved with 41.3% (p=0.001), respectively 1.19 (improved with 68.1%) at 12 months, at group 1 (p=0.001); and from 3.73 to 3.08 at 6 months, improved with 17.4% (p=0.012) and respectively 19%, with a score
of 3.02 at 12 months of traditional kinetic treatment at group 2 (p=0.004). Among the analyzed groups significant statistic differences were registered, the average values have decreased at 6 and at 12 months, with priority at the treated group through modern kinetic methods (p<0.001) (fig. 11).

Fig. 11. The average values of the score BASMI on the groups of study at the 3 assessments

5. The functional perspectives depend on the seriousness with which the patients obey the medical recommendations; at reassessment vs pre-treatment the score HAQ-DI did not highlight improvements with statistic differences (p>0.05); but there were signaled improvements with 11.6% at group 1 and 5.2% at group 2. Between the two groups there were highlighted significant statistic differences, the average values have increased, improving the quality of life, especially at patients of group 1, treated with modern kinetic methods (at 6 months, p=0.008; at 12 months, p<0.001) (fig. 12).
6. In our study the drug therapy (NSAIDs) was influenced like this: at 6 months, the share of patients treated by means of modern kinetic methods decreased from 52,1% to 43,8%, while at 12 months they also received 14,6% of them; to those of group 2 it fell from 54,2% to 50% at 6 months and at 1 year, they also received 52,1%, signaling only at the end of the study statistically significant percentage differences between the two groups (p = 0,0002).

With regard to the administration of drug biologic therapy at 6 months, at the patients from group 1 it dropped from 20,8% to 16,7%, 14,6% respectively at 12 months; at group 2 (18,8%) remained the same at 6 and 12 months (18,8%) insignificantly statistically (p>0,05).

7. ASAS 20% criteria determine the treatment’s response establishment, as variable “respondent”/”non-respondent”; frequency distributions showed significant differences (p=0,003) at 6 months of treatment: at group 1, the share of respondents subjects was of 43,8%; in group 2, the share of respondents subjects was of 12,5%;
At the second evaluation, at 12 months of treatment, the share of respondents subjects from group 1 (72,9%) was significantly greater than that recorded at group 2 (6,3%) (p=0,001), a fact reflected by fig. 13.

Fig. 13. The distributions of respondent subjects on groups

CHAPTER VIII
FINAL CONCLUSIONS

1. The ankylosing spondilitis, chronic inflammatory disease, with immune determinism that belongs to the sphere *spondyloarthropathies*, offers numerous aspects that need determinations on the functional of the patients’ perspectives, depending on the seriousness with which they obey to the medical recommendations.

2. In the Rheumatology Clinic of the Clinical Rehabilitation Hospital from Iaşi, in the period 2008-2010 there were registered a number of 737 (90,98%) of
hospitalizations of the patients with AS, with axial affectation, and monitoring aimed at 393 cases who were present to specific health surveillance at regular intervals.

3. Watching the frequency of AS patients’ hospitalizations within the clinic, it was found the predominance of cases with a single hospitalization (48,09% and respectively 13,23% at age categories of 45-54 years old) of those coming from the urban environment (41,38% of A study; B study 57,35%; 60,02% of the study C).

4. From hospital admissions recorded, most were in the age category of 35-44 years (from 25,23%), while of those of 393 patients hospitalized, the preponderance was observed in the age category 45-54 years (25,19%).

5. AS in the stage without vertebral modifications is marked by epidemiologic characteristics of 68 cases registered (17,30%), which are also defined in the present study as significant: the average start age of the disease was situated around 25 years; it belongs to both sexes in a proportion of 6,6/1 in favour of men; it belongs to both origin environments, in a proportion approximately equal (1,3/1); the biggest frequency of the patients was included in the age interval of 25-29 years (47,05%); the diagnostic sums up identified radiological aspects in the stage III of sacroiliitis (study B).

6. Regarding the clinical and functional profile of the patient with AS in sacroiliitis stage, it was noticed in the initial moment, pre-treatment: a score VAS of the lumbosacral pain, as being defined at a moderate intensity (average value of 54,55); the mobility of the spinal column was limited (DDS = -18,90 cm; Schober = 2,66 cm; Ott = 2,42 cm; DIE = 3,30 cm); and Bath
indices showed average values considered to be at a “functional” level, regarding the axial flexibility, fatigue and “disability”; medicine consumption highlighted that the weighting was of those with NSAIDs, at those being with the age of over 25 years (38,6%) (study C).

7. Besides the early diagnostic, which allows an efficient therapeutical approach and from the large number of physical methods that spondilitic benefits from, a precise monitorization is necessary of the exercises types even from the pre-ankylosing stage; in our study it was observed the efficiency of the therapeutical protocole which was carried out at home after 6 months; ASAS parameters (pain, spinal column’s mobility, chest expansion, of Bath indices: BASDAI, BASFI, BASMI) they were improved at the experimental group (group 1), that group which followed Pilates, McKenzie and Heckscher exercises, in comparison with the witness group (group 2) and the group of the retrospective study treated by traditional kinetic rehabilitation ways.

8. Regarding the objective assessment of the therapeutical response suggested by the group ASAS, through composite indices ASAS20, at 6 months of kinetotherapy instituted at home, the weight of subjects who answered to therapy was of 43,8% at group 1, in comparison with 12,5% at group 2 and with 30,7% at the group of C retrospective study.

9. The results of the study regarding the appreciation of the modern kinetic methods’ efficiency (Pilates, McKenzie and Heckscher) at patients with AS in preventing the respiratory dysfunction of restrictive type, plead for the importance of this multimodal program,
which proves to be comparable or even more favourable than the traditional one in certain situations; this is translated by the enhancement of pain with 62.9% for patients treated with modern kinetic methods and with 39.5% for patients of the witness group, trained with exercises from the traditional program.

10. Following the prevention of spinal column’s mobility loss, Pilates, McKenzie and Heckscher methods ensured together with the appropriate increase of the muscular tonus and an articular – muscular progressive stretching; static exercises solicited in an evident way the paravertebral muscles and of the belts, orienting the basin in a neutral position and influencing the spinal column’s curves (DDS; Schober; Ott p<0.001).

11. The awareness of the respiratory act and the correction of the axial curves imposed by the kinetic modern methods have contributed to the increase of freedom grade of the movements, thus influencing the posture and the pulmonary function, the chest expansion (DIE) improving with 49.2% at the patients who performed Pilates, McKenzie and Heckscher exercises and with 13.7% for those who performed traditional kinetotherapy.

12. Pilates, McKenzie and Heckscher exercises being strictly individualized, offered the possibility of adaptation, in comparison with the stage of the disease, taking into consideration the reduced effort capacity (of inflammatory causes), and also the limited cardio-respiratory resources; a favourable impact on the particular aspects of AS, influencing the activity, the physical function and structural damages, determine the final result, on the anatomic structures of the locomotor
system; BASDAI score has improved with 61.2% vs 21.9%; BASFI with 57.9% vs 19.3%; BASMI with 68.1% vs 19%.

13. The quality of the rheumatic patient’s life carries the mark of the respective illness, especially on the spinal column, which allows to this to integrate itself by moving to the environment; the values of HAQ-DI score have improved with 11.6% for patients who have performed a modern kinetic program and with 5.2% for those who performed traditional kinetic program.

14. Pilates, McKenzie and Heckscher multimodal program has proved, that it is an accessible way of physical training for patients with AS, giving the possibility to be practised anywhere and without devices, in order to improve the physical condition and emotional state.

15. The weight of patients treated through modern kinetic methods, who needed anti-inflammatory dose of NSAIDs at the end of study, has decreased up to 14.6%, in comparison with those treated through traditional kinetic methods, who represent a percent of 52.1%.

16. The results which lead to a therapeutic alteration with choosing the most efficient scheme, ASAS20 clues have registered at the end of the study, static differences, the weight of the respondent subjects from the group with modern kinetic program (72.9%) was significantly more increased unlike that registered at group 2 (6.3%) with traditional kinetic program.

17. Starting from the principle “as rachis is the same way the thorax is”, in the incipient stages of the disease, when the spinal column, costovertebral articulations and costosternal were not blocked by the ascending evolution
of the disease, kinetotherapy by its modern means and methods, stretching, posturing, breathing control, evidently contributes to the prevention of pulmonary dysfunction.

CHAPTER IX
PERSPECTIVES WHICH THESIS OPENS

The present thesis has as a main objective to ensure the increase of the quality of the recovery medical act, covering the little existing information in the published literature of current use, regarding the role of modern methods, like Pilates, McKenzie and Heckscher, which can find their place in improving the clinical and functional parameters of AS, preventing the disease’s progression and the deterioration of the breathing capacity.

Knowing the firm relationship between the structures and the function of the spinal column and the pulmonary compliance, modern methodology modulates much more beneficially, for long periods, the resources of AS patient.

Modern kinetic ways that were suggested for maintaining the breathing mobilizing volumes in normal limits, as long as possible in AS, can constitute the basic support of future research, by opening new perspectives of practical approach.

I consider that it is the first prevention study of restrictive ventilatory dysfunction in AS, which could determine the professional curiosity of other specialists as well, in order to value more these modern methods of recovery, together with the traditional ones.
The study constitutes a useful guide for the assimilation, education, and awareness of a posture and implicitly of a correct breathing by the patient with AS, even from the before-ankylosing stages, offering information on the theoretical and methodological bases of the kinetotherapy to the specialists from the medical recovery field and not only.

**Selective bibliography**


33. Queiroz BC, Cagliari MF, Amorim CF et al. Muscle activation during four Pilates core stability


Scientific Works published from the PhD theme:


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