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OUR EXPERIENCE REGARDING EFFECTS OF SOME ADVANCED PHYSICAL-KINESIOLOGIC REHABILITATION METHODS ON BALANCE DISORDERS IN ADOLESCENTS WITH CEREBRAL PALSY – PARTIAL RESULTS

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Introduction. Background. Normal postural equilibrium function and – when disturbed, no matter the cause – its re-gaining, is crucial for the affected person's global functionality, self-autonomy and connected quality of life. This goes, as well, for the adolescents with Cerebral Palsy (CP) who, within the overall marked disabling potential of this morbid entity, may encounter also balance disorders, thus being in need for rehabilitation in this purpose, too, and seem to benefit from including some newer approaches, provided by advanced physiatrist devices and associated interventions.

Methods. The study was deployed since the fourth quarter of 2017 until 9.12.2019.

Results and Discussion. There have been determined statistically significant beneficial differences, comparing the related data collected at initial and final evaluations, between the outcomes obtained with classical therapeutic-rehabilitative approach and with the topic, diversified and augmented ones, used (see in the body text), for most of the parameters and scales assessed: Gross Motor Function Measure, and respectively Ellipse area, Standard torso deviation, Average speed of the pressure center – in the antero-posterior and partially in the medial-lateral, directions – , Global Stability Index (including, for all, in favor of the "Intensive" dose procedural mode, but with values below 1 degree, respectively 2 mm/s – except for the medial-lateral direction, in closed eyes situation: a reduction of almost 4 mm/s – or respectively, 1mm); likewise for the latter, there has been observed a significant beneficial difference between the initial and final evaluations regarding the both different dose procedural modes availed in the study lots/ groups (but not in between them), on the Pediatric Balance Scale.

*Conclusion***.** The two different dose procedural modes ("Moderate" and "Intensive" – see in the body text) used in the study lots/ control groups have advantages: the former is less demanding and thus, easier to be applied and followed by the patients – including with their kin/ tutors – but the latter appears more efficient. So, larger such study lots/ control groups are necessary in order to even more reliably – based on a higher statistical power – establish which of them is of choice for further clinical use.

Key words: adolescents, cerebral palsy, equilibrium/ balance, stabilometry, kinesiotherapy, robotics, virtual/ augmented reality.

INTRODUCTION

Bipedal orthostatism and gait are features of paramount importance for humanity, in a fundamental and exhaustive way: from basic physiology to the tailoring of our civilization, which from homes and other private or respectively, public buildings, to almost all kind of activities – with lucrative or leisure purpose – entail our above mentioned specific, vertical posture walking.

But bipedalism is an as useful as complicated evolutionary progress humans have achieved, harder to be provided and sustained than quadrupedy, exposing individuals to falls – possibly with severe, even life-threatening, consequences – therefore being underpinned on an extremely complex, subtle and performant neuro-myo-arthro-kinetic infrastructure, able to prevent such risk, and on the other hand, fitting our overall functionality to the usual: family, social and work, environments. Thereby, equilibrium is a critical, complex function, and when damaged – of different causes – it can generate severe disability, hence being always a major rehabilitation objective.

Cerebral palsy (CP) is a type of pediatric pathology "… attributed to non-progressive disturbances that occurred in the developing fetal

or infant brain … alterations in the neuromuscular and musculoskeletal systems may occur in CP as a consequence of the chronic motor impairment…"[1].

The motor disorders of CP … often accompanied by … musculoskeletal problems[1]. Balance is one of the functions that – within the neuro-locomotor (and not only), often extended disability it induces – are not seldom affected in CP, this pathologic condition being (largely) systematized taxonomically by the Surveillance of Cerebral Palsy in Europe (SCPE) Collaborative Group, in: spastic, ataxic dyskinetic and non-classifiable[2] – and respectively, by the Swedish afferent classification, as: "spastic (hemiplegic, tetraplegic, and diplegic), dyskinetic (dystonic and athetotic), ataxic and unclassified/ mixed"[3]. Consistent details on this subject matter have been presented elsewhere[4]. Consequently, endeavors aiming to ameliorate equilibrium imparment, are necessary, including in CP. In our clinic division we use, aside classical appropriate physical exercise/ kinesio-therapeutical techniques/ methods, advanced interventions, of stabilometric, robotized and virtual/ augmented reality (VR/ AR), kinds, for balance assessment and (re-) training, including in CP, so herein is presented the experience we have accumulated in this respect, and the partial relatd outcomes.

METHODS

This study was carried out in the fourth quarter of 2017 – the approval being obtained from the Ethics Commission – No: 7661 dated: 19/10/2017 – within the National Clinical Center for Neuropsychomotor Rehabilitation in Children "Dr. N. Robănescu" (NTCNRCNR), Bucharest and aimed at adolescents with CP, in order to address the re-training of their consequent balance disorders, using, as a therapeutic-rehabilitative means, key tools for motivating/participating and enhanced related re-learning, facilities of virtual/ augmented reality (VR/AR) and robotics, types, including to objectively compare in between dosage elements.


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AVIZ STUDIU CLINIC

Comisa de Etică a Centrului Național Clinic de Recuperare Neuropsihomotorie Copii "Dr.Nicolae Robănescu" avizează efectuarea studiului stiintific cu respectarea normelor de etică a cercetării stiințifice, în scopul realizării Tezei de Doctorat cu titlul" Cercetări referitoare la principale optiuni metodologice in interventii mediate prin realitate virtuala, pentru tratament recuperator, in tulburari de echilibru la copii si adolescenti cu paralizie cerebrala (predominant) ataxica" a domnului Kinetoterapeut Avram Radu Mihai.

Președinte Comisia de Etică,
Conf.Univ.Dr.Liliana Pădure

CENTRUL NATIONAL CLINIC DE RECUPERARE NEUROPSIHOMOTORIE COPII "DR. NICOLAE ROBĂNESCU" BUCUREȘTI ROMANIA

Am primit un exemplar

The project encompassed three lots/ control groups: the control lot/ group, with 89 patients constituted retrospectively retrospectively (*i.e.* the same patients included in one of the lots/ groups within the the Doctoral Thesis of Dr. Andrada Mirea, with her kind corresponding consent): availed precisely because it is suitable, although with limits (see further) for comparison between lots – who have been tested with the scale "Gross Motor Function Measure (GMFM)", as a connection with our two study lots (see below); a second rationale for its use: the patients in this group performed just (22: 2/ day in weekdays and 1/ day in weekends) physio-/ kinesio-therapy sessions, during hospitalization (with a length-of-stay of 12 days in the NTCNRCNR); each session lasted 30 minutes, and to be specified that we did not take any new cases with this approach schemata since because of the accentuated and sustained dynamics of the the NTCNRCNR's endowment level: in recent years patients with CP, in addition to classical, adequate kinesio-therapy, have used also (among 1 larger panel of devices/ facilities to be possibly administered): Geo(5), Nirvana(6), Myro(7); so, for an effective comparison, as lot that performed just kinesio-therapy, we considered the above mentioned retrospective existing group as being the only appropriate.

Study lot/ control group I (constituted prospectively): moderately complex treatment – 40 patients, adolescents – with a total administration dose of therapeutic-rehabilitative interventions, within an overall 75 minutes[8] algorithm (see Tables 1 and 2) – based on related recommendations found in the literature.

Study lot/ control group II (constituted prospectively): complex intensive treatment – 34 patients, adolecents of which 14 were added from the "Pilot study on evaluation methods and physiotherapy, apparatus, advanced, methodologically coordinated, to address static and balance disorders in pediatric patients with PC – preliminary results", poster at the 13th Annual Congress of the Romanian Medical Association April 18 – April 20, 2019[9]) – which received a total administration dose of the therapeutic-rehabilitative interventions, within an overall 90 minutes[10] algorithm (see Tables 1 and 2) – also based on the related recommendations found in the literature. To be specified that in both study lots/ control groups we included only – Adolescents is the period between 13 to 19 years of age …"[11] – because of some safety concerns regarding the use of the VR, especially of immersive type, in children, as reported in the literature ("... most major VR headset manufacturers assign a 13-plus age restriction to their devices. Plus, headset user guides warn of health dangers ranging from eye strain and headaches to nausea and, in rare cases, seizures".[12]

Each study control group benefited from standardized treatment in terms of duration, intensity and specific procedures, applied only for a period of 5 days – both algorithms: of 75 minutes, respectively of 90 minutes, being divided into two sessions, according to the from the above mentioned literature data.

To be specified that kinesio-therapeutic exercises – including availed in the therapeutic-rehabilitative approaches[14] of the inpatients of the NTCNRCNR are tabularly presented in Annex I and the synoptic panel of the evaluation/ measurements customized unitary protocol used in our clinical study and of the afferent results, are presented in Annex II.

In order to quantify the functional status of the patients enrolled in this study, and to objectively evaluate the effectiveness of the above specified, applied, therapeutic-rehabilitative intervention programs, we performed standardized measurements, using seven parameters, respectively scales.

Table 1

List and durations of interventions applied in the lots/ control groups of patients included in this trial

Lot/ Group	Classical Kinesio-Therapy	Stability and Balance Training – Modern Apparatus Facility(PRO-KIN 252)(13)	Myro (VR/ AR)	NIRVANA (VR/ AR)	Geo (ROBOTICS + VR/ AR)	Time
Control Lot/ Group witness	30'	-	-	-	-	30'
Study Lot/ Group I	20'	15'	10'	10'	20'	75'
Study/ Lot Group II	20'	15'	10'	15'	30'	90'

More precisely, we used four "posturographic"[15,16] assays – the measurements extracted from the apparatus tests: "Romberg" and "Global Stability Index (based on horizontal bipodal balancing)", performed by the Advanced Device Pro-kin 252, equipped with: platform, 4 force cells which measures the activity of COP (center of pressure) at the plant level and a sensor applied to the patient's xiphoid appendix (TRUNCK SENSOR), which generates data on the movements of the COM (center of body mass).

The following data were extracted and sampled at a frequency of 20 Hz: 1. "Ellipse area (in mm^2)", 2. "Standard torso deviation (in °)", 3. "Average speed of the center of pressure in antero-posterior (AP) direction (in mm/ s)", 4."Average speed of the center of pressure in medial-lateral (ML) direction (in mm/ s)", 5. "Global Stability Index (based on horizontal bipodal balancing – in mm)", 6. "Gross Motor Function Measure (GMFM)-66(17) – the only one including retrospectively, as above explained) – numerically compatible for statistical processing –, 7. "Pediatric Balance Scale (PBS)"[18].

DESCRIPTION OF THE APPARATUS TESTS WE USED

1. Romberg test analyze the static position of the body in a process of 60 seconds (30" with open eyes – O E – and 30" with closed eyes – C E), through the pressure plate and the sensor on the torso (TRUNCK SENSOR – placed on the xiphoid appendix).

2. Stability Index Test (assesses dynamic balance): analyzes the distance between the patients' center of mass and the plate center in a 30" process, only with the eyes open. This parameter allows understanding the patient's overall imbalance relative to center of the plate.

The test position is an orthostatic, unshod, standardized, relaxed one, with the feet abducted 10° and (or parallel – o.n. – according to the workbook[13] of the related device – in the NTCNRCNR endowment) and the heels spaced 3 cm in between, in frontal plane, the upper extremities along with the body, and the eyes open[16], and the gaze focusing on a screen, at a distance of about 1 meter[13].

THE STATISTICAL PROCESSING METHODOLOGY OF THE PRIMARY DATA OBTAINED

For statistical processing, demographic data, descriptive statistics were calculated and comparison tests were used – Kolmogorov-Smirnov, parametric (type t/ ANOVA – with actual situational adaptations through post-hoc tests: Tamhane, respectively Fisher's Least Significant Difference), non-parametric (Mann-Whitney/ Wilcoxon) –, correlation (Pearson), graphical representations by box-plot diagrams or histograms.

Figure 1. Advanced (computerized) stabilometry/ posturographic quantified testing and training apparatus (Pro-Kin 252), including with visual feed back (from the NTCNRCNR casuistry).

The threshold of statistical significance was a value of $p < 0.05$ and the confidence level was 95%, with related intervals afferent to the respective calculated averages.[19,20]

As IT infrastructure, there has been accessed/ used the software "Statistical Package for Social Sciences" (SPSS 24), for Windows and Microsoft Excel 2007.

RESULTS

Tables 2, 3 and 4

Descriptive demographic data, by age and gender, within the control and the two study lots/ groups

Age (months)

Group	N	Minimum	Mean	Maximum
Control	89	24	89,29	212
Moderate	40	156	163,80	204
Intensive	34	156	171,88	216
Total	163	24	124,80	216

Gender

		Frequency	Percent
Valid	F	75	46,0
	M	88	54,0
	Total	163	100,0

Group * Gender Crosstabulation

			Gender		
			F	M	Total
Group	Control	Count	37	52	89
		% within Gender	49,3%	59,1%	54,6%
	Moderate	Count	22	18	40
		% within Gender	29,3%	20,5%	24,5%
	Intensive	Count	16	18	34
		% within Gender	21,3%	20,5%	20,9%
	Total	Count	75	88	163
		% within Gender	100,0%	100,0%	100,0%

Tables 5 and 6

Data regarding clinical-functional and topographic diagnostics within the control and the two study lots/ groups

Group * Topography Crosstabulation

			Topography				
			DI	HEMI	TETRA	TRI	Total
Group	Control	Count	33	7	47	2	89
		% within Topography	42,9%	33,3%	74,6%	100,0%	54,6%
	Moderate	Count	22	8	10	0	40
		% within Topography	28,6%	38,1%	15,9%	,0%	24,5%
	Intensive	Count	22	6	6	0	34
		% within Topography	28,6%	28,6%	9,5%	,0%	20,9%
	Total	Count	77	21	63	2	163
		% within Topography	100,0%	100,0%	100,0%	100,0%	100,0%

Topography

		Frequency	Percent
Valid	DI	77	47,2
	HEMI	21	12,9
	TETRA	63	38,7
	TRI	2	1,2
	Total	163	100,0

COMPARATIVE STATISTICAL ANALYSES

The area of the ellipse, in the "open eyes" (O.E.) case.

It is observed that there are patients who have "exceptionally high" values. Namely, patient #1 is visibly "exceptional".

For the accuracy of the mathematical processing it is necessary to eliminate the cases considered outliers from a statistical point of view, by restricting the value of the ellipse area, at the initial moment, to a maximum of 6000 mm^2.

Thus, 3 cases are eliminated, namely: #1, #30 from the "Moderate" group, as well as #9 from the "Intensive" group.

After elimination of these values/ cases, 38 patients remain in the "Moderate" group and 33 in the "Intensive" group.

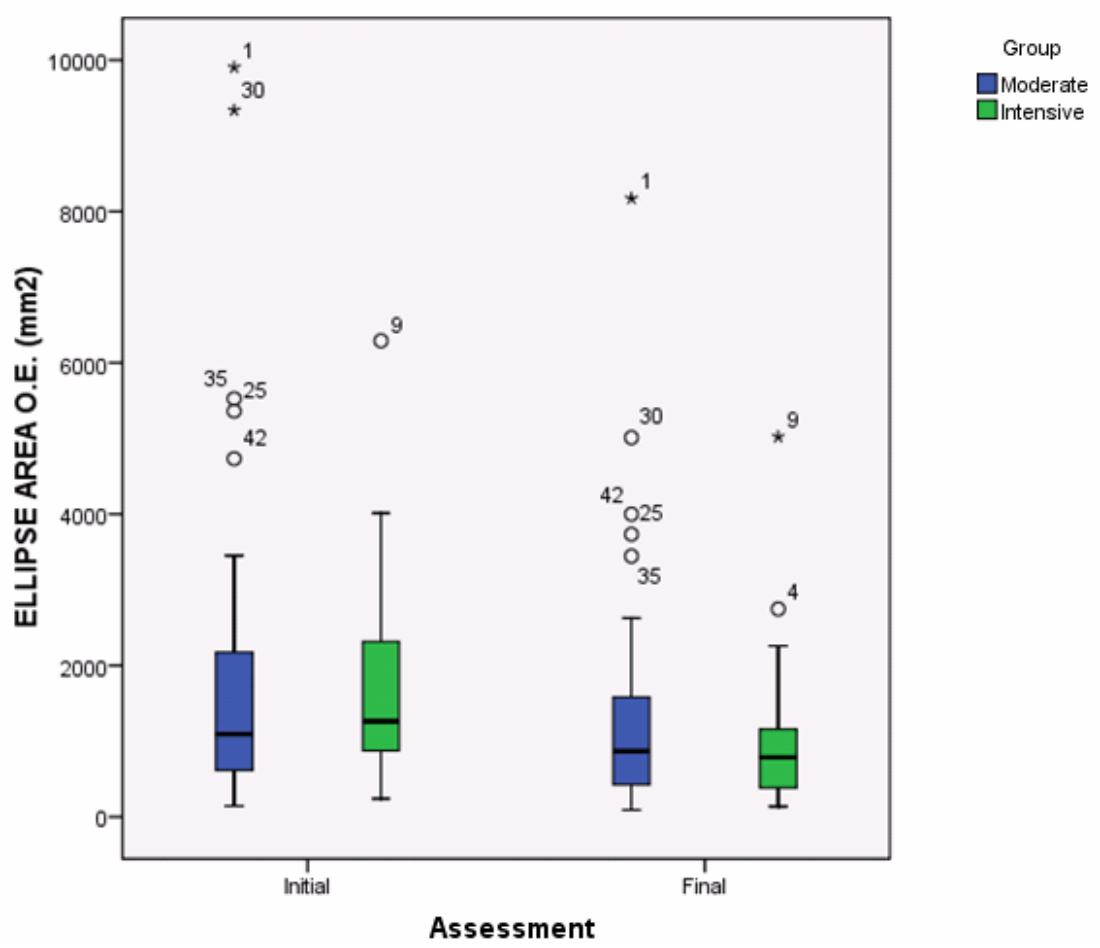


Figure 2. The box-plot diagram showing the overall situation of the ellipse areas, for the two study groups, at the time of the assessments: initial and final, in the O.E. situation.

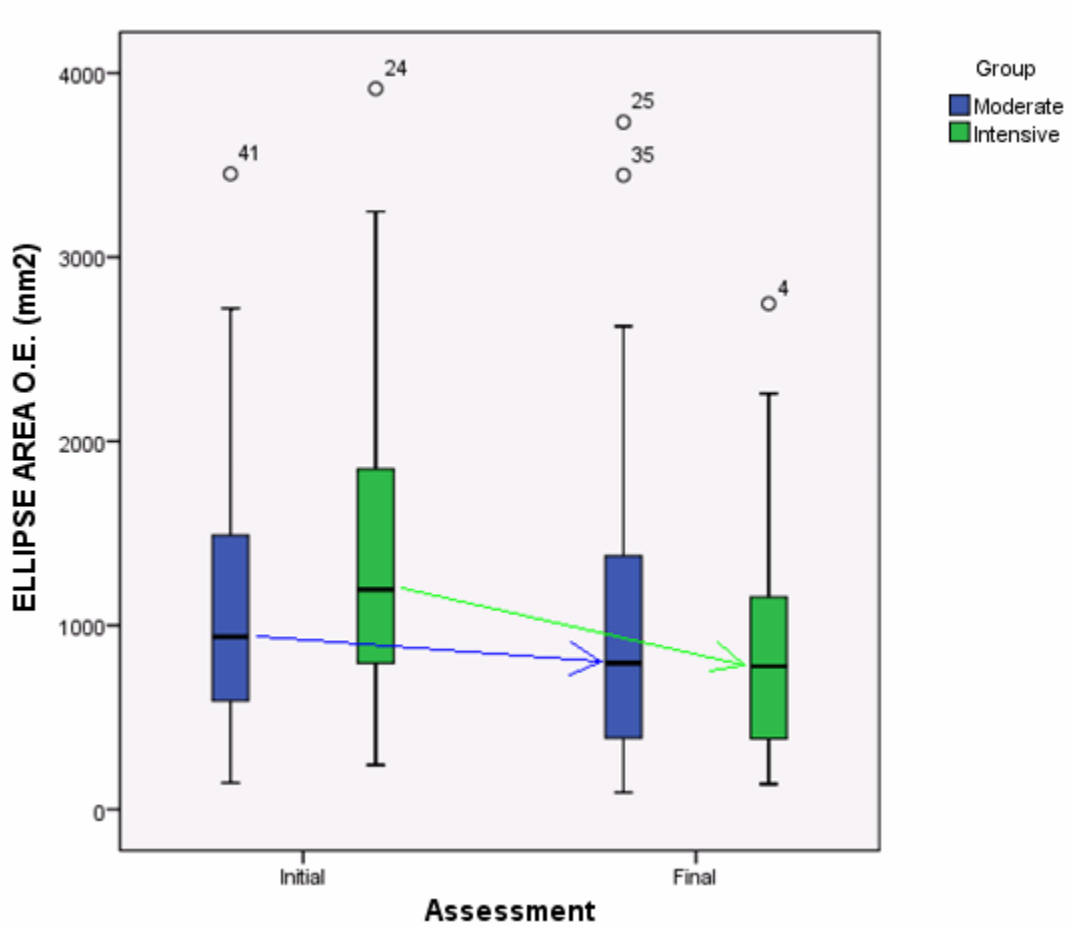
The area of the ellipse, in the situation of O.E. – at initial assessment (before treatment):

From the histograms related to the data of the Ellipse Area – at the initial assessment – for the two study groups, in the O.E. situation, there are apparent deviations from normality. But the Kolmogorov-Smirnov normality test produces a p-value of 0.081 attached to the "Moderate" group, respectively 0.527 attached to the "Intensive" group. The second (0.527) is above the 0.2 threshold of acceptance of data normality, and the first (0.081) is not below the 0.05 threshold of categorical rejection of normality; therefore, in order to compare the groups we used the t-test (independent samples). This test attaches a p-value of 0.909 (well above the threshold of 0.05) to the statement that "group averages differ significantly from each other", so it does not confirm it, instead points to a similarity of groups.

The area of the ellipse O.E. – at the final assessment (after treatment):

From the histograms related to the situation of the ellipse area data in the two study groups – at the final assessment (after treatment), for the O.E. situation, there are also some deviations from normality. The Kolmogorov-Smirnov normality test produces, however, a p-value of 0.263 attached to the "Moderate" group, respectively 0.653 attached to the "Intensive" group. Both are above the 0.2 threshold for accepting data normality; therefore, in order to compare the groups we are fully entitled to use the t-test (independent samples).

The t-test (independent samples) attaches a value p = 0.237 (above the significance threshold of 0.05) to the statement that "group averages differ significantly from each other", so it does not confirm it.



(Note all box-plots are built around the respective medians, but t-tests compare the respective means!)

Figure 3. The box-plot diagram showing the situation of the ellipse areas after deleting outliers, for the two study groups, at the time of the assessments: initial and final, in the O.E. situation.

There is a more pronounced decrease in the values of the ellipse areas, in the case of O.E. in the case of the "Intensive" group.

Analyzing separately, at the level of each study group, it is observed, for the "Moderate" group, a decrease of the average value of the ellipse areas, in the O.E. situation, from 1480 to 1106 mm^2, so a decrease of 374 mm^2. This decrease is statistically significant, with a unilateral p-value of 0.001 attached to it, well below the significance threshold of 0.05.

For the "Intensive" group, the decrease is from 1512 mm^2 to 876 mm^2, so a decrease of 836 mm^2. This decrease is statistically significant (p-value <0.001). The difference, as a clinical-therapeutic benefit, of the dosage of the "Intensive" scheme compared to the "Moderate" treatment, can be appreciated/ objectified instrumentally, in terms of ellipse area values, in the OE situation, by an additional decrease of the ellipse area by 836–374 = 462 mm^2.

The area of the ellipse,
in the situation of "closed eyes" (C.E) case

It is observed that there is at least one patient with "exceptionally high" values of the ellipse area.

For the accuracy of the mathematical processing it is necessary to eliminate the cases considered outliers from a statistical point of view, by restricting the value of the ellipse area, at the initial moment, to a maximum of 8000 mm^2. Thus, a single case: #18, from the "Moderate" group, is eliminated. Consecutively, 39 patients remain in the "Moderate" group and 34 in the "Intensive" group.

The area of the ellipse, in the situation of C.E. – at the initial assessment

From the histograms related to the data of the Ellipse Area – at the initial assessment, in the two study groups, in the C.E. situation, it is found that there are apparent deviations from normality. But the Kolmogorov-Smirnov normality test produces a p-value of 0.193 attached to the "Moderate" group, respectively 0.842 attached to the "Intensive" group. The second (0.842) is above the 0.2 threshold for accepting data normality, and the first (0.193) is close to this threshold, in any case it is not below the 0.05 threshold of categorical rejection of normality; therefore, in order to compare the groups we could use the t-test (independent samples).

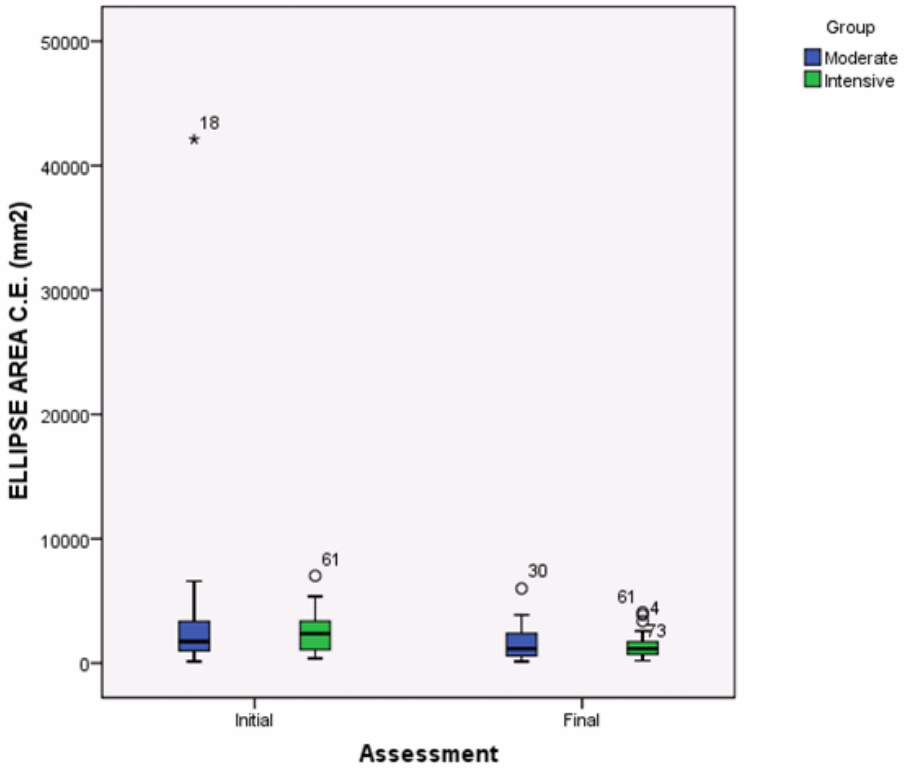


Figure 4. The box-plot diagram shows the overall data regarding the ellipse areas, for the two study groups, at the time of the assessments: initial and final, in the situation of C.E.

The t-test attaches a value p = 0.517 (well above the threshold of 0.05) to the statement that "group averages differ significantly from each other", so it does not confirm it.

The area of the ellipse, in the situation of C.E. – at the final assessment

From the histograms related to the ellipse area data situation, in the C.E. – at the final assessment – in the two study groups, there are also some deviations from normality. The Kolmogorov-Smirnov normality test produces a p-value of 0.075 attached to the "Moderate" group, respectively 0.363 attached to the "Intensive" group. The second (0.363) is above the 0.2 threshold of accepting data normality, and the first (0.075) is not below the 0.05 threshold of categorical rejection of normality; therefore, in order to compare the groups, we could, however, use the t-test (independent samples).

T-test attaches a value p = 0.549 (above the significance threshold of 0.05) to the statement that "group averages differ significantly from each other", so it does not confirm it.

There is a more pronounced decrease in the values of the ellipse areas, in the case of C.E., in the case of the "Intensive" group.

We use the paired t-test to compare the values from the initial assessments with the final ones, for each of the two study groups.

It is observed, for the "Moderate" group, a decrease of the average value of the areas of the ellipses C.E. from 2223 to 1563 mm2, so a decrease of 660 mm^2. This decrease is statistically significant, with a unilateral p-value <0.001 attached to it.

For the "Intensive" group, the decrease is from 2478 mm^2 to 1401 mm^2, so a decrease of 1077 mm^2. And this decrease is statistically significant (p-value <0.001).

The difference, as a clinical-therapeutic benefit, between the dosage of the "Intensive" scheme compared to the "Moderate" treatment, can be appreciated/ objectified instrumentally, in terms of ellipse area values, in the EC situation, by an additional decrease of the ellipse area by 1077 – 660 = 417 mm^2.

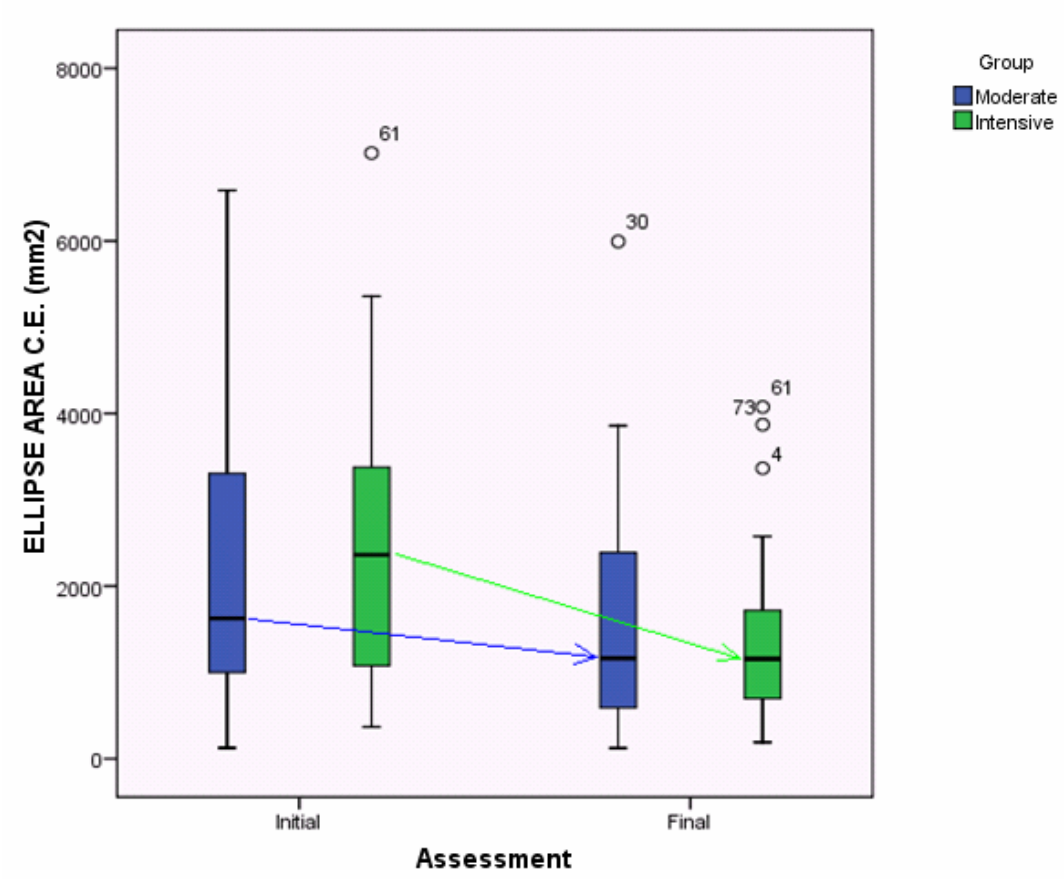


Figure 5. The box-plot diagram shows the data regarding the ellipse areas, outliers deleted, for the two study groups, at the time of the assessments: initial and final, in the situation of C.E.

Deviation of the trunk

The deviation of the trunk, in the of O.E. case

It is observed that there are patients who have "exceptionally high" values, namely, patient #1 is visibly "exceptional".

For the accuracy of the mathematical processing, it is necessary to eliminate the cases considered outliers from a statistical point of view, by restricting the deviation of the trunk to a maximum of 9 degrees.

Thus, 4 cases are eliminated, namely: #1, #25, #30 from the "Moderate" group, as well as #49 from the "Intensive" group. After elimination of these values/ cases, 37 patients remain in the "Moderate" group and 33 in the "Intensive" group.

The deviation of the trunk, in the situation of O.E. – at the initial assessment

From the histograms related to the data of the deviation of the trunk – at the initial assessment, in the two study groups, in the O.E. situation, it is found that there are some apparent non-normality of data. However, the Kolmogorov-Smirnov normality test produces a p-value of 0.676 attached to the "Moderate" group, respectively 0.093 attached to the "Intensive" group. The first (0.676) is above the 0.2 threshold of acceptance of data normality, and the second (0.093) is not below the 0.05 threshold of categorical rejection of normality; therefore, in order to compare the groups we could use the t-test (independent samples).

T-test attaches a value p = 0.236 (above the threshold of 0.05) to the statement that "group averages differ significantly from each other", so it does not confirm it.

The deviation of the trunk O.E. – at the final assessment

From the histograms related to the trunk standard deviation data situation, in the O.E. – at the final assessment – in the two study groups, there are also some deviations from normality. The Kolmogorov-Smirnov normality test produces a p-value of 0.318 attached to the "Moderate" group, respectively 0.024 attached to the "Intensive" group.

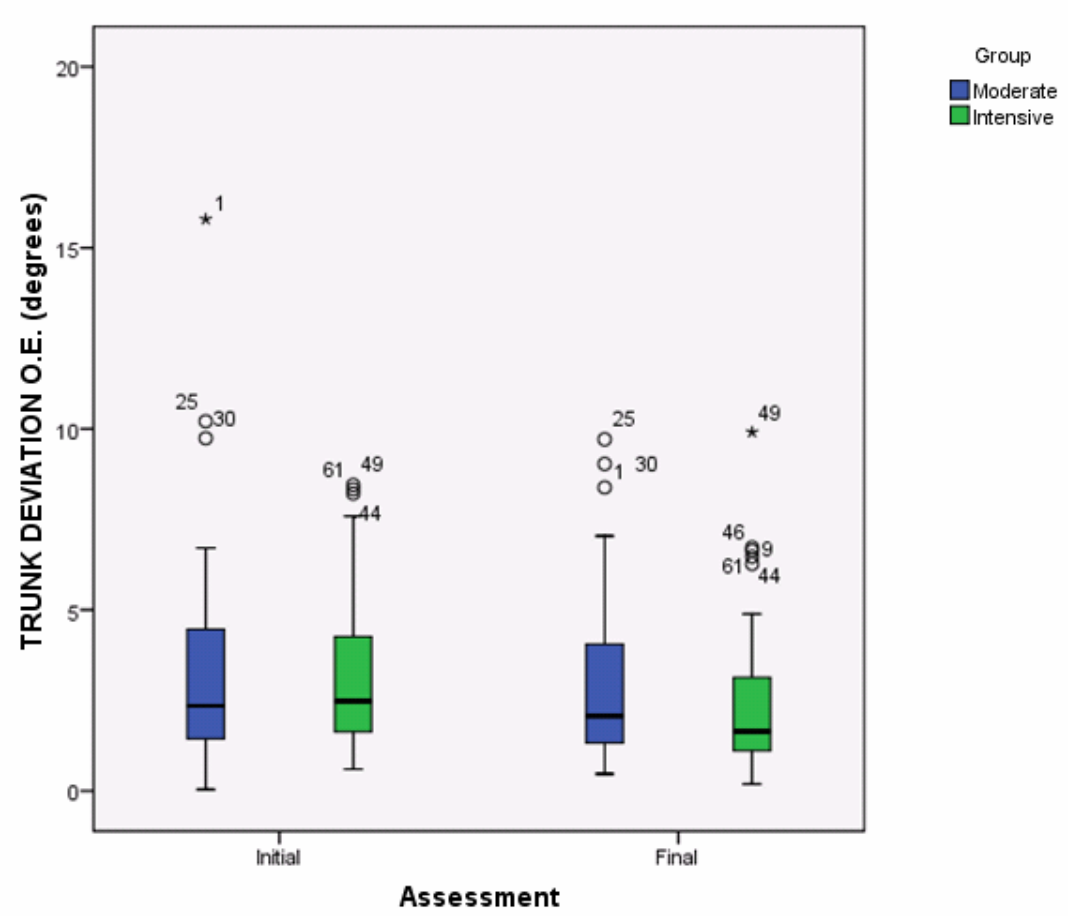


Figura 6. The box-plot diagram showing the overall data of the deviation of the trunk, for the two study groups, at the time of the assessments: initial and final, in the situation of O.E.

Table 7

Non-parametric Mann-Whitney test (M-W) results

Ranks

	Group	N	Mean Rank	Sum of Ranks
TRUNK DEVIATION, O.E. Final (grade)	Moderate	37	37,38	1383,00
	Intensive	33	33,39	1102,00
	Total	70		

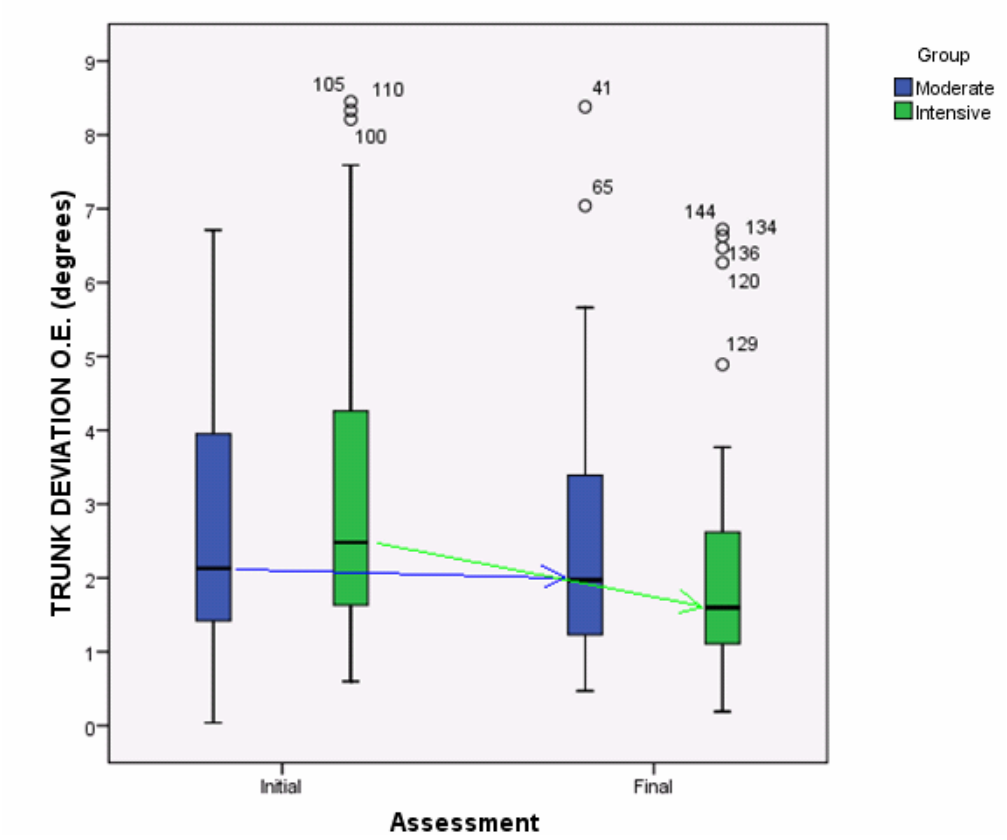


Figure 7. Comparison between the assessment moments: initial and final, of the two study groups, taking into account the trunk deviation (O.E. case).

The first (0.318) is above the 0.2 threshold for accepting data normality, but the second (0.024) is below the 0.05 threshold for categorical rejection of normality; therefore, in order to compare the groups, we could not use the t-test (independent samples) and we had to limit ourselves to the non-parametric Mann-Whitney test (M-W). This test is based not on the actual values of the trunk deviation, but on their ranks, and tries to compare the mean ranks for the two groups: associating a p-value with the statement that "the mean ranks differ in the two groups".

However, the obtained p-value is 0.414, well above the significance threshold of 0.05. Therefore, the available data do not allow us to state anything, from the statistical point of view, about differences between the two groups (of course, from the point of view of the values of trunk deviation, in the O.E. situation, at the final assessment).

A more pronounced decrease in the values of the deviation of the trunk O.E. seems to appear in the case of the "Intensive" group.

We use the paired t-test to compare the initial values with the final ones, separately for each of the two study groups.

For the "Moderate" group, there is a decrease in the average value of the trunk deviation O.E. from 2.61 to 2.41 degrees, so a decrease of 0.2 degrees. This decrease is not statistically significant, with a unilateral p-value of 0.190 attached to it, well above the significance threshold of 0.05.

For the "Intensive" group, the decrease is from 3.21 degrees to 2.29 degrees, so a decrease of 0.92 degrees. This decrease is statistically significant (p-value <0.001).

The difference, as a clinical-therapeutic benefit, between the dosages of the "Intensive" scheme compared to the "Moderate" treatment, can be appreciated/ objectified instrumentally, in terms of the values of the deviation of the trunk, in the OE situation, by an average decrease of 0.92 – 0.20 = 0.72 degrees.

The deviation of the trunk, in the situation of C.E.

As above, it is noticed here that there are patients who have "exceptionally high" values. For the accuracy of the mathematical processing, it is necessary to eliminate the cases considered outliers from statistical point of view, by restricting the deviation of the trunk to a maximum of 10 degrees. Thus, 3 cases are eliminated, namely: #1 and #25 from the "Moderate" group and #49 from the "Intensive" group. After elimination of these values/ cases, 38 patients remain in the "Moderate" group and 33 in the "Intensive" group.

The deviation of the trunk, in the situation of C.E. – at the initial assessment

From the histograms related to the trunk deviation data situation, in the C.E. – at the initial assessment – in the two study groups, there are also apparent non-normality. However, the Kolmogorov-Smirnov normality test produces a p-value of 0.319 attached to the "Moderate" group, respectively 0.255 attached to the "Intensive" group. Both are above the 0.2 threshold for accepting data normality, therefore, in order to compare groups we could genuinely use the t-test (independent samples).

T-test attaches a value p = 0.993, close to 1, to the statement that "group averages differ significantly from each other"; so it does not confirm it but, on the contrary, there are statistical reasons to say that the data from the two groups are similar.

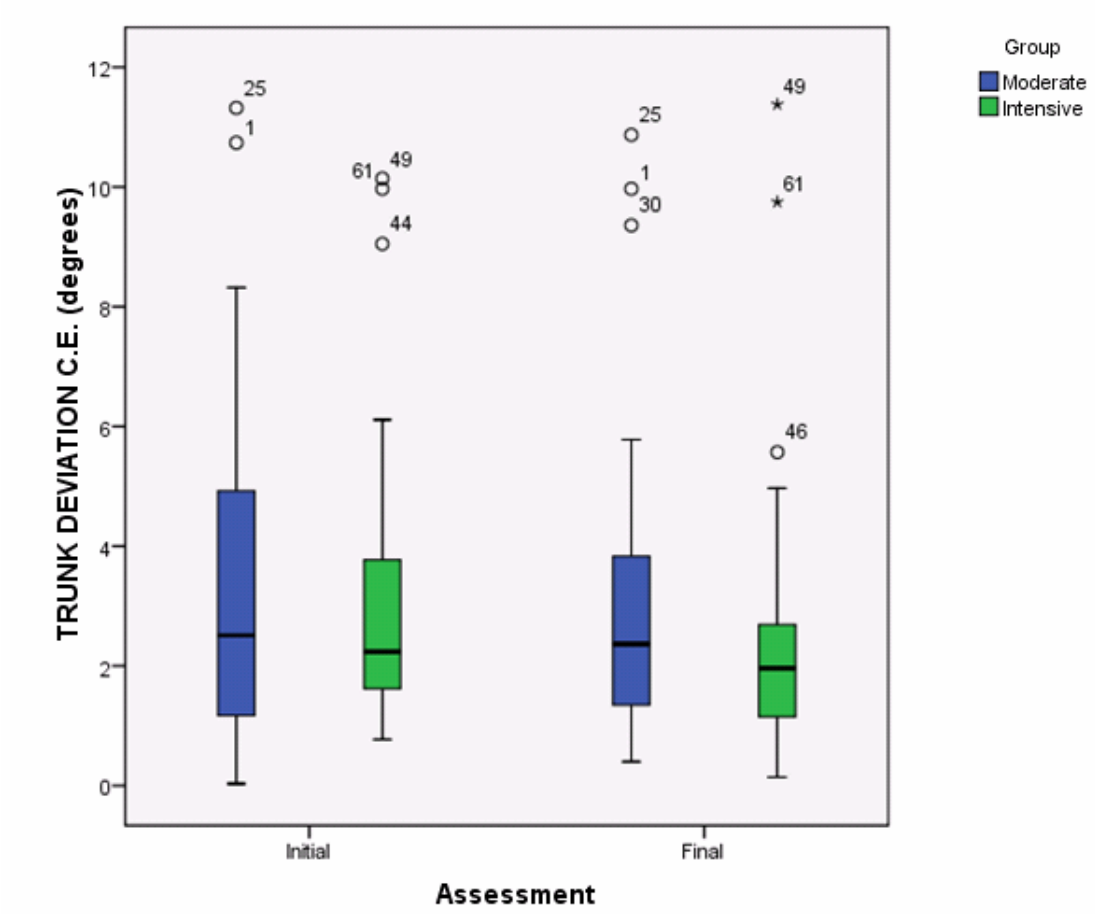


Figure 8. The box-plot diagram showing the overall data of the deviation of the trunk, for the two study groups, at the time of the assessments: initial and final, in the situation of C.E.

The deviation of the trunk, in the situation of C.E. – at the final assessment

From the histograms related to the trunk deviation data situation, in the C.E. – at the final assessment – in the two study groups, there are also some apparent non-normality. The Kolmogorov-Smirnov normality test produces a p-value of 0.059 attached to the "Moderate" group and 0.049 respectively attached to the "Intensive" group. The first (0.059) is above the 0.05 threshold, but the second (0.049) is below the 0.05 threshold of categorical rejection of normality; therefore, in order to compare groups, we will have to limit ourselves to the non-parametric Mann-Whitney test.

The corresponding mean ranks are as presented in Table 10.

There is a higher average of the ranks in the case of the "Moderate" group (39.1 degrees) than the one calculated for the "Intensive" group (of 32.5 degrees). But the test associates a p-value of 0.177 with the statement that "the mean ranks differ in the two groups", well above the significance threshold of 0.05. Therefore, the gathered data do not allow us to say anything, from a statistical point of view, about differences between the two study groups in terms of trunk deviation values, in the case of C.E. at the final assessment.

Table 8

Non-parametric Mann-Whitney test (M-W) results

Ranks

	Group	N	Mean Rank	Sum of Ranks
TRUNK DEVIATION C.E. Final (grade)	Moderate	38	39,08	1485,00
	Intensive	33	32,45	1071,00
	Total	71		

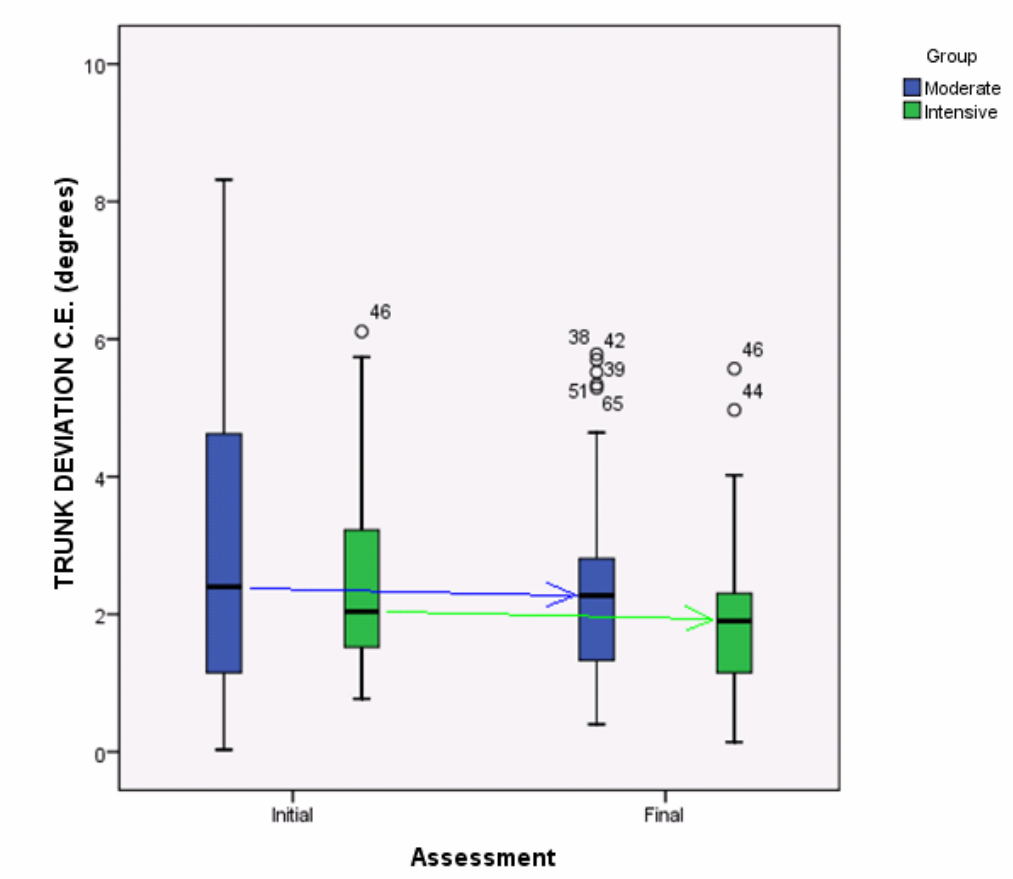


Figure 9. Comparison between the assessment moments: initial and final, of the two study groups, taking into account the trunk deviation (C.E. situation).

There is a somewhat similar decrease in the values of trunk deviation, in the case of C.E., in the case of the two study groups.

As usual, we use the paired t-test to compare the initial and final values for each of the two study groups.

There is, for the "Moderate" group, a decrease of the average value of the trunk deviation, in the C.E. situation, from 2.98 to 2.71 degrees, so a decrease of 0.27 degrees. This decrease is not statistically significant, with a unilateral p-value of 0.198 attached to it, well above the significance threshold of 0.05.

For the "Intensive" group, the decrease is from 2.98 degrees to 2.27 degrees, so a decrease of 0.71 degrees. This decrease is statistically significant (p-value <0.001).

The difference, as a clinical-therapeutic benefit, between the dosages of the "Intensive" scheme compared to the "Moderate" treatment, can be instrumentally appreciated/ objectified, in terms of the values of the C.E. trunk deviation, by an average decrease of 0.72 – 0.27 = 0.45 degrees.

As clinical-functional reasoning, we mention the fact that, in the case of this parameter, the results – at the final assessment, both in the situation of O. E. and C. E. – objectified differences of less than one degree; thus, although statistically significant in the case of the study group that followed "Intensive" treatment, in the practice of medical recovery, they are quite difficult to observe.

Average speed of the center of pressure antero-posterior (A-P)

It is observed that there are patients who have "exceptionally high" values. For the accuracy of the mathematical processing it is necessary to eliminate the cases considered outliers from a statistical point of view, by restricting the value of the average speed of the pressure center, at the time of the initial assessment, to a maximum of 40 mm/s.

Thus, 5 cases are eliminated, namely: #1, #30, #41, #56 from the "Moderate" group and #29 from the "Intensive" group. After elimination of these values/ cases, 36 patients remain in the "Moderate" group and 33 in the "Intensive" group.

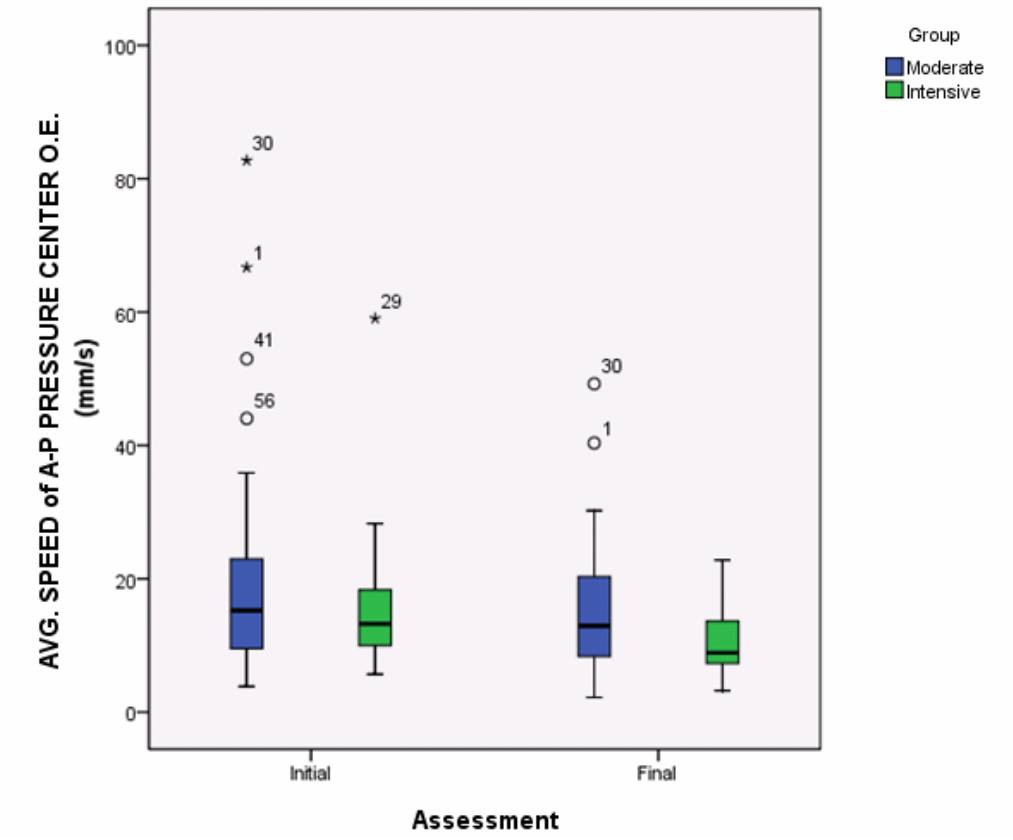


Figure 10. The box-plot diagram shows the overall data regarding the average speeds of the A-P pressure centers, for the two study groups, at the time of the assessments: initial and final, in the O.E. situation.

The average speed of the A-P pressure center, in the situation of O.E. – at the initial assessment

From the histograms related to the data of the average speed of the A-P pressure center – at the initial assessment – in the two study groups, in the O.E. situation, it is found that there is also apparent non-normality. However, the Kolmogorov-Smirnov normality test produces a p-value of 0.415 attached to the "Moderate" group, respectively 0.692 attached to the "Intensive" group. Both are above the 0.2 threshold for accepting data normality; therefore, in order to compare the groups we could genuinely use the t-test (independent samples).

It is found that the average of the A-P average speeds, in the OE situation, at the initial assessment, for the "Moderate" group (15.47 mm/s) is only slightly higher than the average for the "Intensive" group (which is 14.26 mm/s).

T-test (independent samples) attaches a value p = 0.505 (well above the threshold of 0.05) to the statement "group averages differ significantly from each other", so it does not confirm it.

The average speed of the A-P pressure center, in the situation of O.E. – at the final assessment

From the histograms related to the data of the average speed of the A-P pressure center – at the final assessment – in the two study groups, in the O.E. situation, it is found that there are also deviations from normality. The Kolmogorov-Smirnov normality test produces a p-value of 0.139 attached to the "Moderate" group, respectively 0.289 attached to the "Intensive" group. The second is clearly above the threshold of 0.2 for accepting the normality of data, and the first is not below the threshold of 0.05 for categorical rejection of normality; therefore, in order to compare the groups we could use the t-test (independent samples).

It is found that the average of the A-P average speeds, in the O.E. situation, at the final assessment, for the "Moderate" group (of 13.3 mm/s) is higher than the other average for the "Intensive" group (which is 10.4 mm/s).

T-test (independent samples) attaches a value p = 0.063 (above the significance threshold of 0.05) to the statement that "group averages differ significantly from each other", so it does not confirm it.

There is a more pronounced decrease in the values of the average speed of the A-P pressure center, in the O.E. situation, in the case of the "Intensive" group.

We use the paired t-test to compare the initial values with the final ones, for both groups.

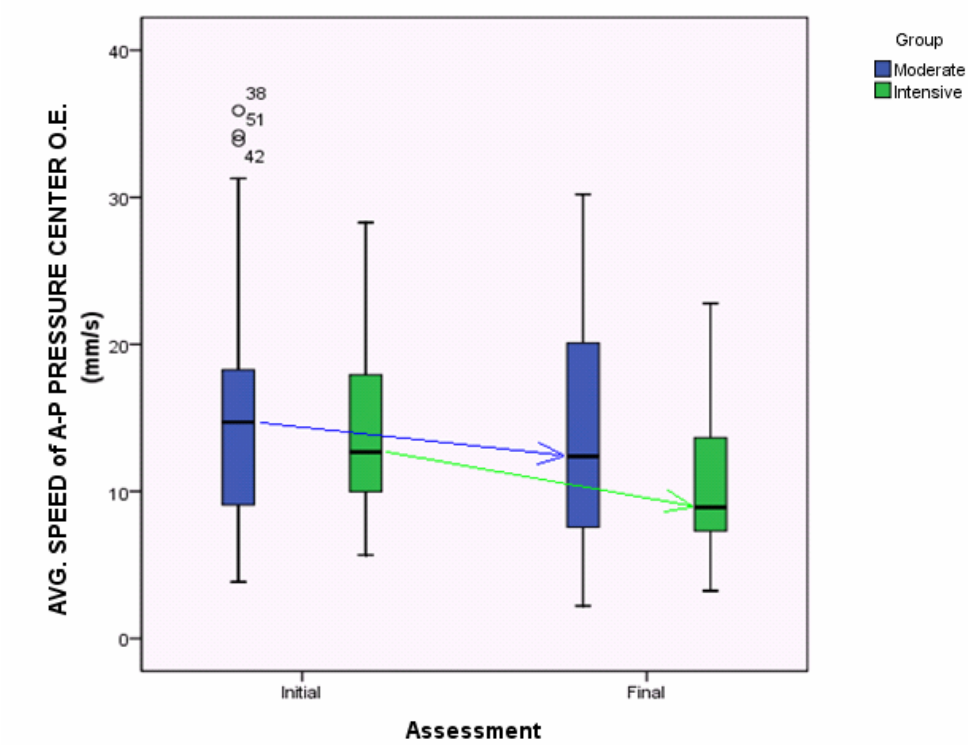


Figure 11. Comparison between the assessment moments: initial and final, of the two study groups, taking into account the A-P average speeds (O.E. situation).

There is, for the "Moderate" group, a decrease of the average value of the average speed of the A-P pressure center, in the O.E. situation, from 15.5 to 13.3 mm/s, so a decrease of 2.2 mm/s. This decrease is statistically significant, with a unilateral p-value of 0.002 attached to it, well below the significance threshold of 0.05.

For the "Intensive" group, the decrease is from 14.3 mm/s to 10.4 mm/s, so a decrease of 3.9 mm/s. This decrease is statistically significant (p-value < 0.001).

The difference, as a clinical-therapeutic benefit, between the dosages of the "Intensive" scheme compared to the "Moderate" treatment, can be appreciated/ objectified instrumentally, in terms of the values of the average speed of the A-P pressure center, in the O.E. situation, by an additional decrease of the average speed with 3.9 – 2.2 = 1.7 mm/s.

The average speed of the A-P pressure center, in the situation of C.E.

It is observed that there are patients who have "exceptionally high" values. For the accuracy of the mathematical processing, it is necessary to eliminate the cases considered outliers from a statistical point of view, by restricting the value of the average speed of the pressure center, at the initial moment, to a maximum of 55 mm/s. Thus, 2 cases are eliminated, namely: #1 and #30 from the "Moderate" group. After elimination of these values/ cases, 38 patients remain in the "Moderate" group and 34 in the "Intensive" group.

The average speed of the A-P pressure center, in the situation of C.E. – at the initial assessment

From the histograms related to the data of the average speed of the A-P pressure center – at the initial assessment – in the two study groups, in the C.E. situation, it is found that there is apparent some non-normality. But the Kolmogorov-Smirnov normality test produces a p-value of 0.208 attached to the "Moderate" group, respectively 0.933 attached to the "Intensive" group. Both are above the 0.2 threshold for accepting data normality; therefore, in order to compare the groups we genuinely use the t-test (independent samples).

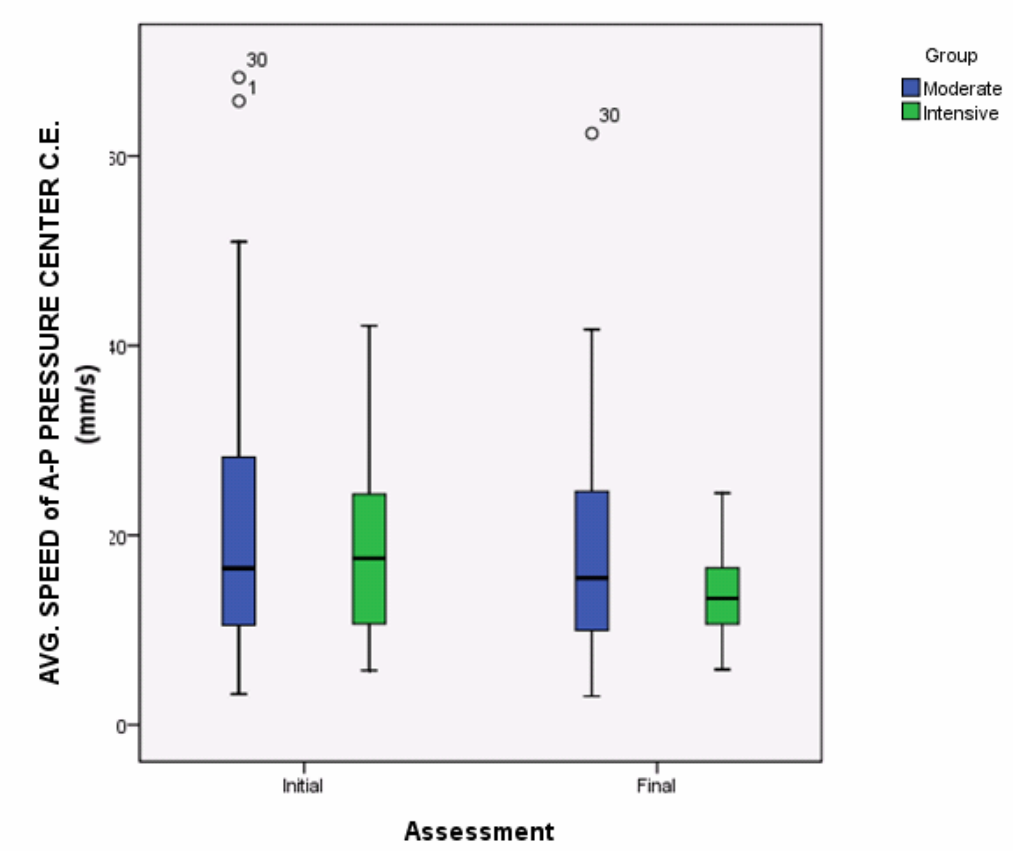


Figure 12. Comparison between the assessment moments: initial and final, of the two study groups, taking into account the A-P average speeds (C.E. situation).

It is noted that the average of the average AP speeds, in the E.C. situation, at the initial assessment, for the "Moderate" group (19.6 mm/s) is only slightly higher than the average for the "Intensive" group (which is 18.2 mm/s) .

T-test attaches a bilateral p-value = 0.584 (well above the threshold of 0.05) to the statement that "group averages differ significantly from each other", so it does not confirm it.

The average speed of the pressure center A-P, in the situation of C.E. – at the final assessment

From the histograms related to the data of the average speed of the pressure center A-P – at the final assessment – in the two study groups, in the C.E. situation, it seems that there are also deviations from normality, especially in the "Moderate" group. However, the Kolmogorov-Smirnov normality test produces a p-value of 0.576 attached to the "Moderate" group, respectively 0.927 attached to the "Intensive" group. Both are clearly above the 0.2 threshold for accepting data normality; therefore, in order to compare the groups we genuinely use the t-test (independent samples).

It is observed that the average of the A-P average speeds, in the situation of C.E., at the final assessment for the "Moderate" group (of 16.5 mm/s) is higher than the average for the "Intensive" group (which is 13.7 mm/s).

The t-test (independent samples) attaches a value p = 0.097 (above the significance threshold of 0.05) to the statement that "group averages differ significantly from each other", so it does not confirm it.

There is a slightly more pronounced decrease in the values of the average speed of the A-P pressure center, in the situation of C.E., in the case of the "Intensive" group.

We use the paired t-test to compare the initial values with the final ones, for both groups.

It is observed, for the "Moderate" group, a decrease of the average value of the average speed of the A-P pressure center, in the situation of C.E. from 19.6 to 16.5 mm/s, so a decrease of 3.1 mm/s.

This decrease is statistically significant, with a unilateral p-value of 0.021 attached to it, below the significance threshold of 0.05.

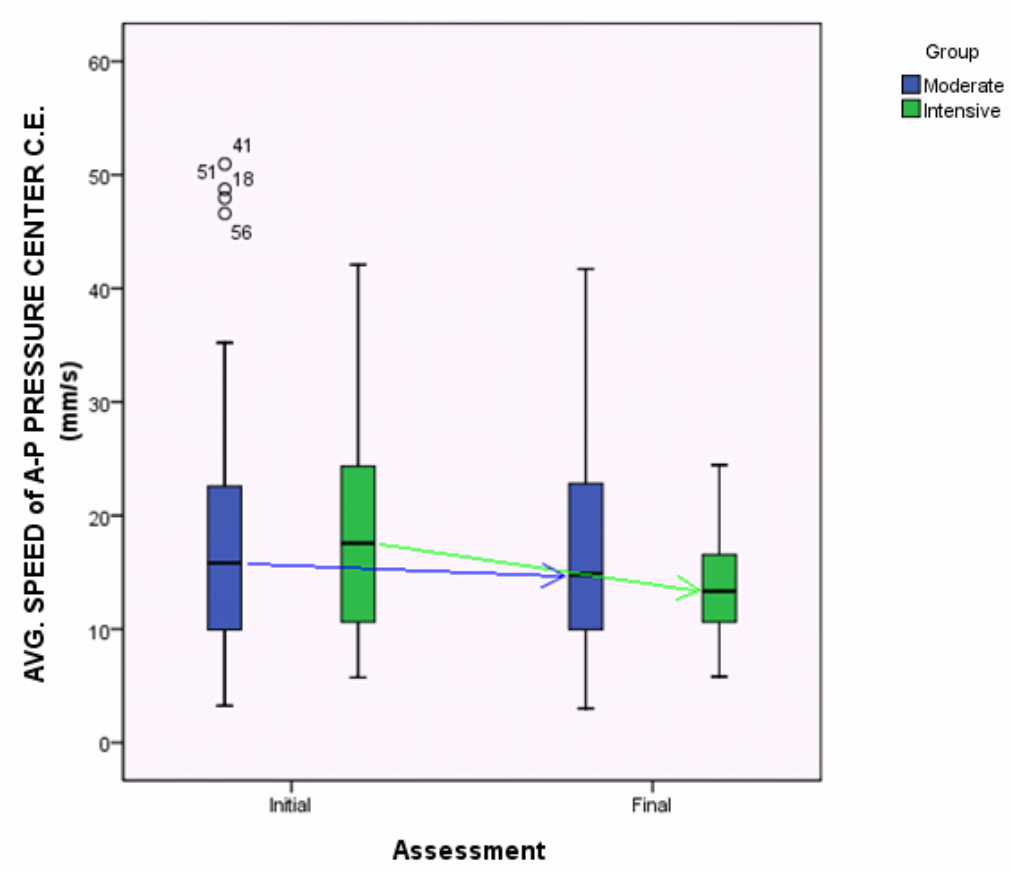


Figure 13. Comparison between the assessment moments: initial and final, of the two study groups (outliers deleted), taking into account the A-P average speeds (C.E. situation).

For the "Intensive" group, the decrease is from 18.2 mm/s to 13.7 mm/s, so a decrease of 4.5 mm/s. This decrease is statistically significant (p-value <0.001).

The difference, as a clinical-therapeutic benefit, between the dosage of the "Intensive" scheme compared to the "Moderate" treatment, the effect of the transition from the "Moderate" to the "Intensive" treatment can be appreciated/objectified instrumentally, in terms of A-P pressure, in the E.C. situation, by a further decrease of the average speed by 4.5 – 3.1 = 1.4 mm/s.

As clinical-functional reasoning, we mention the fact that also in the case of this parameter, – at the final assessment, both in the situation of O. E. and C. E. – the objectified differences of less than 2mm/s, although statistically significant in the case of both study groups, are quite difficult observable in the practice of medical recovery.

Average speed of the Medio-Lateral (M.-L.) pressure center

It is observed that there are patients who have "exceptionally high" values. For the accuracy of the mathematical processing, it is necessary to eliminate the cases considered outliers from a statistical point of view, by restricting the value of the average speed of the pressure center, at the initial moment, to a maximum of 50 mm/s. Thus, two cases are eliminated, namely: #1 and #30 from the "Moderate" group.

After elimination of these values/ cases, 38 patients remain in the "Moderate" group and 34 in the "Intensive" group.

The average speed of the M-L pressure center, in the situation of O.E. – at initial assessment (mm/s)

From the histograms related to the data of the average speed of the M-L pressure center – at the initial assessment – in the two study groups, in the C.E. situation, it seemed that there were apparent deviations from normality. But the Kolmogorov-Smirnov normality test produces p-values of 0.263 attached to the "Moderate" group, respectively 0.084 attached to the "Intensive" group. The first is placed above the threshold of 0.2 of acceptance of data normality, and the second is not below the threshold of 0.05 of categorical rejection of normality; therefore, in order to compare the groups we used the t-test (independent samples).

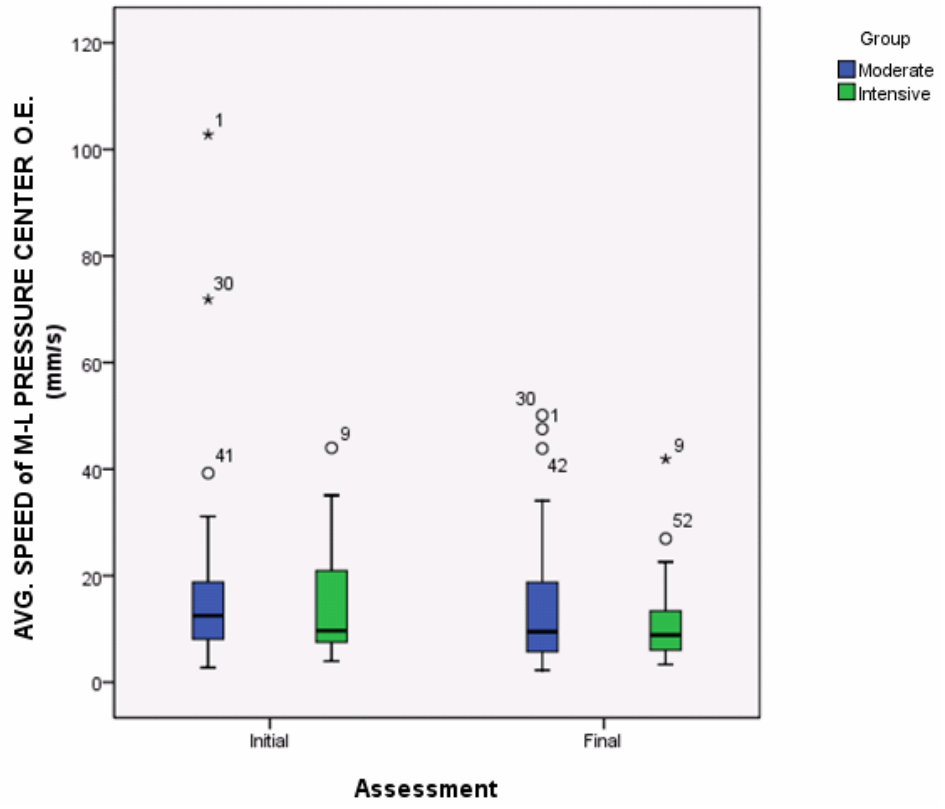


Figure 14. The box-plot diagram showing the overall data regarding the average speeds of the M-L pressure centers, for the two study groups, at the time of the assessments: initial and final, in the O.E. situation.

It is noted that the average of the average ML speeds, in the OE situation, at the initial assessment, for the "Moderate" group (13.88 mm/s) is only slightly higher than the average for the "Intensive" group (which is 14.23 mm/s) .

The t-test attaches a bilateral p-value of 0.872 (close to 1, well above the 0.05 threshold) to the statement that "group averages differ significantly from each other", so not only does it not confirm it, but even suggests that the groups would be similar.

The average speed of the M-L pressure center, in the situation of O.E. – at the final assessment

From the histograms related to the data of the average speed of the M-L pressure center – at the final assessment – in the two study groups, in the C.E. situation, it is clear that there are large deviations from normality. Indeed, the Kolmogorov-Smirnov normality test produces p-values of 0.033 attached to the "Moderate" group, and 0.117 attached to the "Intensive" group. The first is below the 0.05 threshold of categorical rejection of normality; therefore, in order to compare the groups we are bound to use the non-parametric, rank-based Mann-Whitney test.

It is observed that the mean rank of the "Moderate" group (of 37.6 mm/s) is very slightly higher than the mean rank, that of the "Intensive" group (which is of 35.3 mm/s).

The Mann-Whitney test attaches a p-value = 0.648 (much above the significance threshold of 0.05) to the statement that "the averages of the ranks differ significantly between groups", so it does not confirm it.

Table 9

The values of the mean ranks of the average speed ranges
of the M-L pressure center for the two study groups (O.E. case, final assessment)

Ranks

	Group	N	Mean Rank	Sum of Ranks
AVERAGE SPEED OF M-L PRESSURE CENTER, O.E. Final (mm/s)	Moderate	38	37,57	1427,50
	Intensive	34	35,31	1200,50
	Total	72		

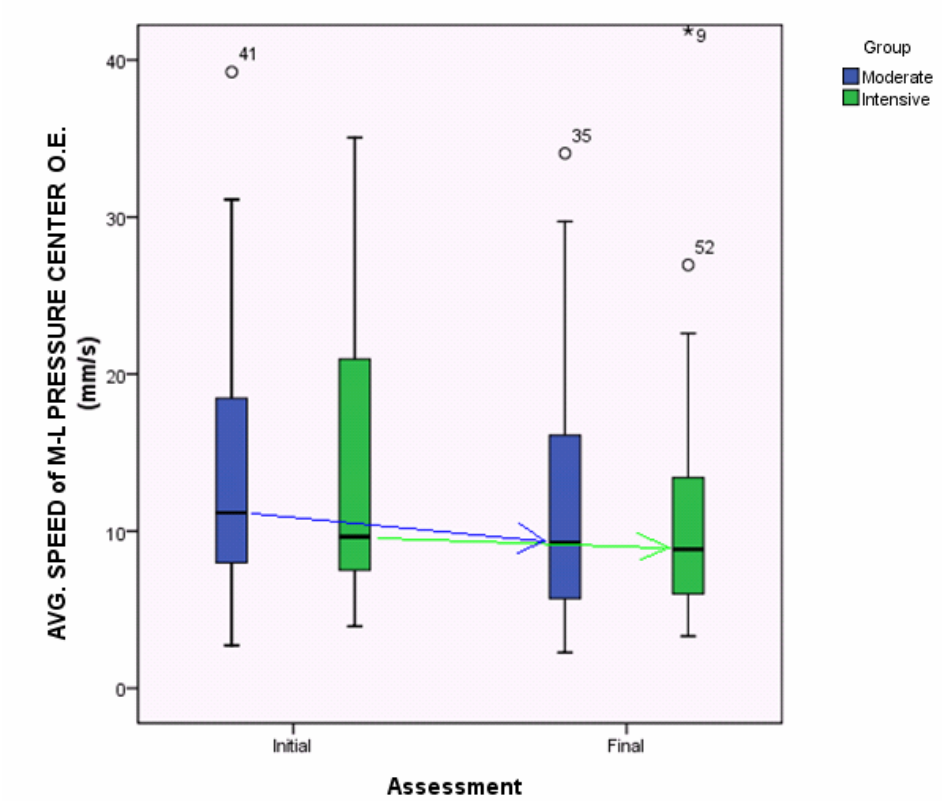


Figure 15. The box-plot diagram showing the data regarding the average speeds of the M-L pressure centers, for the two study groups (outliers deleted), at the time of the assessments: initial and final, in the O.E. situation.

In this particular case, the median of the values of the average speed of the M-L pressure center, in the O.E. situation, from the "Intensive" group, at the initial moment, has a value much lower than their average (by approx. 4 mm/s); therefore, in this diagram, due to the strong asymmetry of the data around the center, a lower decrease of the values of the average speed of the M-L pressure center is observed in the case of the "Intensive" group, which is misleading (an example of possible limitation for any collection of bio-functional data and implicitly of statistical processing).

We present here the results of the (paired) t-test (although not fully justified) which was used to compare final moment data versus initial moment data, for the two groups involved, in the O.E. situation. (Note that the Mann-Whitney test, which is not requesting "normality" validation, gave entirely similar results.)

It is found, for the "Moderate" group, a decrease of the average value of the average speed of the M-L pressure center, in the situation of O.E. from 13.88 to 12.65 mm/s, so a decrease of 1.23 mm/s. This decrease is not statistically significant, with a unilateral p-value of 0.143 attached to it, well above the significance threshold of 0.05.

For the "Intensive" group, the decrease is from 14.23 mm/s to 11.01 mm/s, so a decrease of 3.22 mm/s. This decrease was found statistically significant (p-value = 0.001)

The difference, as a clinical-therapeutic benefit, between the dosages of the "Intensive" scheme compared to the "Moderate" treatment, can be appreciated/ objectified instrumentally, in terms of the values of the average speed of the M-L pressure center, in the OE situation, by an additional decrease of the average speed with 3.22 – 1.23 = 1.99 mm/s.

As clinical-functional reasoning, we mention the fact that also in the case of this parameter, – at the final assessment in the situation of O. E. – the objectified differences of less than 2 mm/s, although statistically significant in the case of the "Intensive" group, are quite difficult to be observed in the practice of medical-recovery care.

The average speed of the M-L pressure center, in the situation of C.E.

It is observed that there are patients who have "exceptionally high" values. For the accuracy of the mathematical processing, it is necessary to eliminate the cases considered outliers from a statistical point of view, by restricting the value of the average speed of the pressure center, at the initial moment, to a maximum of 50 mm/s.

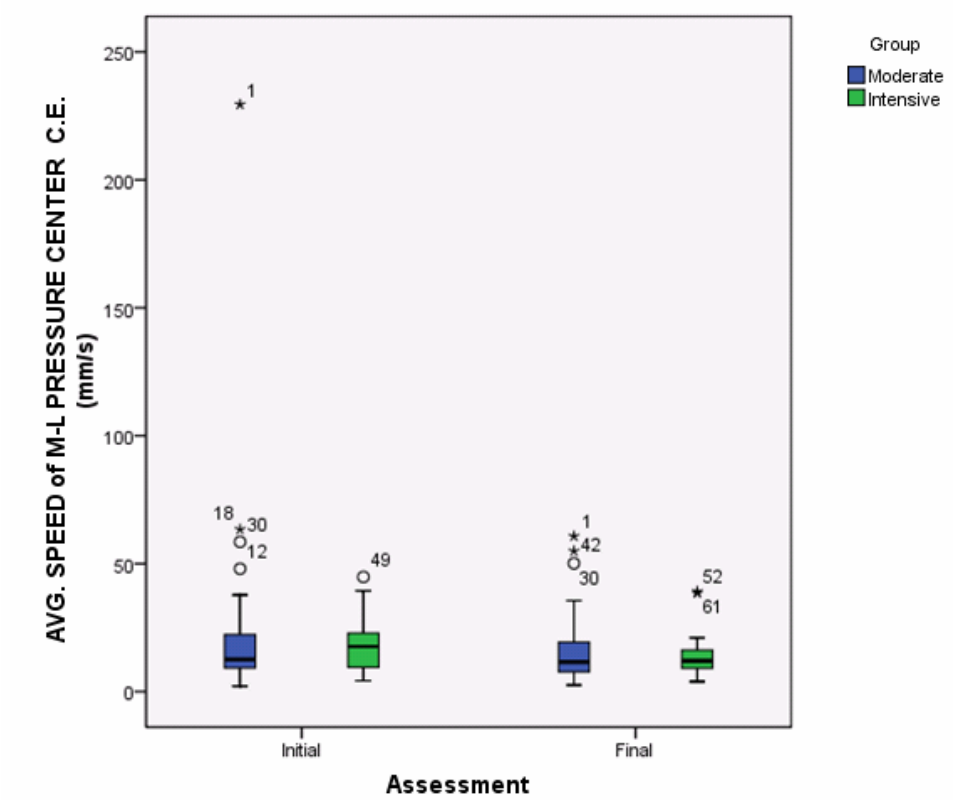


Figure 16. The box-plot diagram showing the overall data regarding the average speeds of the M-L pressure centers, for the two study groups, at the time of the assessments: initial and final, in the situation of C.E.

Thus, 3 cases are eliminated, namely: #1, #18 and #30 from the "Moderate" group.

After elimination of these values, 37 patients remain in the "Moderate" group and 34 in the "Intensive" group.

The average speed of the M-L pressure center, in the situation of C.E. – at the initial assessment

From the histograms related to the data of the average speed of the M-L pressure center – at the initial assessment – in the two study groups, in the C.E. situation, it is found that there are apparent deviations from normality. The Kolmogorov-Smirnov normality test produces a p-value of 0.149 attached to the "Moderate" group, respectively of 0.196 attached to the "Intensive" group. Both are below the 0.2 threshold for accepting data normality, but above the 0.05 threshold for categorical rejection of normality. This is a doubtful statistical context and we opted to use the (independent samples) t-test in order to compare the groups (even if the substantiation of this decision is "at the limit").

It is observed that the average of the M-L average speed, in the C.E. situation, for the "Moderate" group (of 15.77 mm/s) is lower than the corresponding average for the "Intensive" group (which is of 18.36 mm/s).

The (independent samples) t-test attaches a bilateral p-value = 0.304 (above the threshold of 0.05) to the statement that "group averages differ significantly from each other", so it does not confirm it.

The average speed of the M-L pressure center, in the situation of C.E. – at the final assessment

From the histograms related to the data of the average speed of the M-L pressure center – at the final assessment – in the two study groups, in the C.E. situation, it is found (taking into account that the data for patient #48 are missing) that there are still deviations from normal. The Kolmogorov-Smirnov normality test produces a p-value of 0.216 attached to the "Moderate" group, respectively 0.217 attached to the "Intensive" group. Both are at the limit above the threshold of 0.20 acceptance of normality; therefore, in order to compare the groups, we could use the (independent samples) t-test.

It is found that the average of the M-L average speeds, in the C.E. situation, at the final assessment, for the "Moderate" group (of 14.35 mm/s) is higher than the average, from the "Intensive" group (which is 13.32 mm/s).

T-test attaches a bilateral p-value = 0.642 (above the threshold of 0.05) to the statement that "group averages differ significantly from each other", so it does not confirm it.

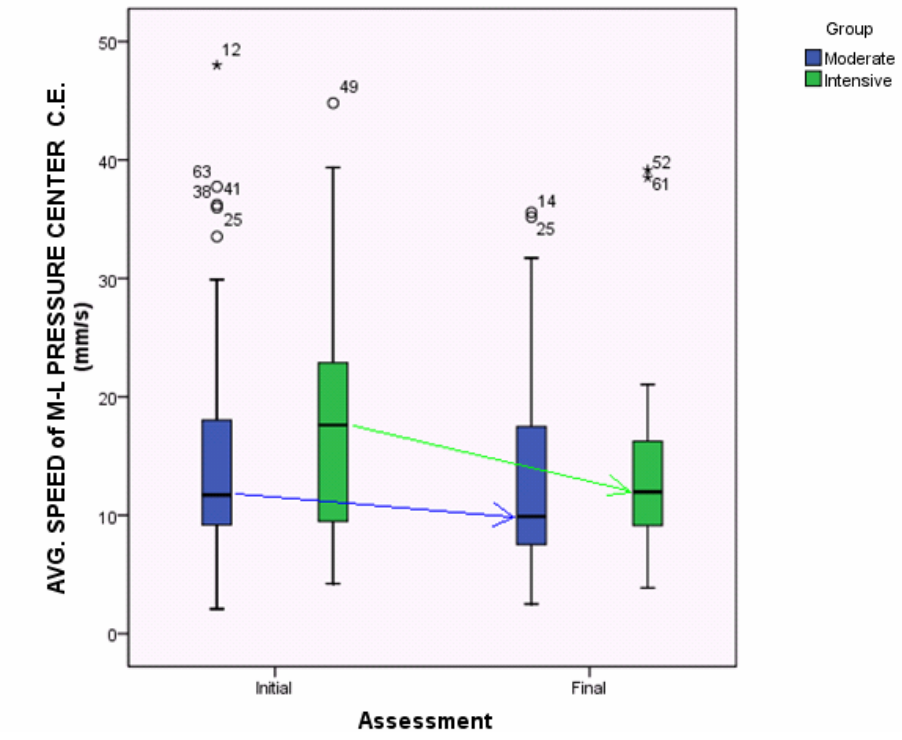


Figure 17. The box-plot diagram showing the data regarding the average speeds of the M-L pressure centers, for the two study groups (outliers deleted), at the time of the assessments: initial and final, in the C.E. situation.

There is a more pronounced decrease in the values of the average speed of the M-L pressure center, in the situation of C.E., in the case of the "Intensive" group.

We will use the paired t-test to compare the initial values with the final ones, for both study groups.

It is found, for the "Moderate" group, a decrease of the average value of the average speed of the M-L pressure center, in the C.E. situation, from 15.77 to 14.35 mm/s, so a decrease of 1.42 mm/s. This decrease is not statistically significant, with a unilateral p-value of 0.178 attached to it, well above the significance threshold of 0.05.

For the "Intensive" group, the decrease is from 18.67 mm/s to 13.32 mm/s, so a decrease of 5.35 mm/s. This decrease is statistically significant (p-value <0.001).

The difference, as a clinical-therapeutic benefit, between the dosages of the "Intensive" scheme compared to that of "Moderate" treatment, can be assessed/ objectively instrumented, in terms of the values of the average speed of the M-L pressure center, in the E.C. situation, by an additional decrease of the average speed with 5.35 – 1.42 = 3.93 mm/s.

Global stability index
(based on horizontal bipodal balancing) – GSI
GSI – at the initial assessment

From the histograms related to the GSI data – at the initial assessment – in the two study groups, it is found that there are apparent slight deviations from normality. But the Kolmogorov-Smirnov normality test produces a p-value of 0.30 attached to the "Moderate" group, respectively 0.11 attached to the "Intensive" group. The first is above the threshold (0.20) of accepting normality and the second is not below the threshold (0.05) of rejecting normality; consequently, we compared the groups by the parametric (independent samples) t-test.

Thus, an average of 3.7 mm is found for the GSI values in the case of the "Moderate" group, slightly higher than the one (of 3.6 mm) in the case of the "Intensive" group.

The bilateral p-value produced by the t-test is 0.831, close to 1, which indicates toward a coincidence of the GSI values in the two groups (rather than a statistical confirmation of the difference.

GSI – at the final assessment

From the histograms related to the GSI data – at the final assessment – in the two study groups, it is found that there is slight apparent deviations from normality. But the Kolmogorov-Smirnov normality test produces a p-value of 0.250 attached to the "Moderate" group, respectively 0.555 attached to the "Intensive" group. Both are above the threshold (0.20) of accepting normality; consequently, we are able to compare the groups by the parametric (independent samples) t-test.

However, the produced bilateral p-value of 0.463, very high compared to the 0.05 threshold of acceptance of statistical significance, does not allow us to draw any statistical conclusion over the differences between the two study groups, based on data collected from patients.

To compare the evolution – between the initial and the final assessment – of the GSI inside the two groups, taking into account the normality checks above, we use the (paired) t-test.

For both assessment times, the test produced a bilateral p-value < 0.001; thus both the differences between the average GSI, of 0.6 mm in the "Moderate" group and of 0.8 mm in the "Intensive" group, are highly statistical significant.

Apparently, there is a more pronounced decrease in the values of the GSI, in the case of the "Intensive" group. However, no significant differences between groups were assessed.

Regarding this parameter (GSI), there is no statistically significant difference between the dosage of the "Intensive" scheme and the "Moderate" treatment as a clinical-therapeutic benefit.

As clinical-functional reasoning, we mention the fact that also in the case of this parameter GSI, the objectified differences of less than 1mm – between the final and initial assessment –, although statistically significant in the case of both study groups, in the practice of medical recovery are quite difficult to observe.

Gross Motor Function Measure (GMFM66)

As a limitation of the present research, we specify the fact that, in order to compare the two categories of advanced rehabilitation treatment (type "Moderate" and respectively, "Intensive" – administered to the study groups), on one hand, with – on the other – the classical way for such an approach (only through kinesiotherapy), we used, retrospectively, a control group in which the clinical-functional assessments were performed by the well-known and internationally recognized scale: GMFM66. The use of this scale requires the approval of its official administrators (https://canchild.ca/system/line_items/10904/819445 5d-8e21-4f51-8243 5edd220deb32/ license_files/ license-10904.pdf). This acceptance was obtained a few years ago by my colleague Dr. Med. Andrada Mirea, – who agreed to be used, for comparative purposes, the control group evaluated by her, through the GMFM scale, in her Doctoral Thesis. It has

became thus possible that all three lots/ groups analyzed in the present study were evaluated using this scale. Thus, the control group – the only methodological "continuity" (partially represented just by kinesiotherapy), through which we could made comparisons with the new methodology (diversified and augmented) that we applied in the two study groups.

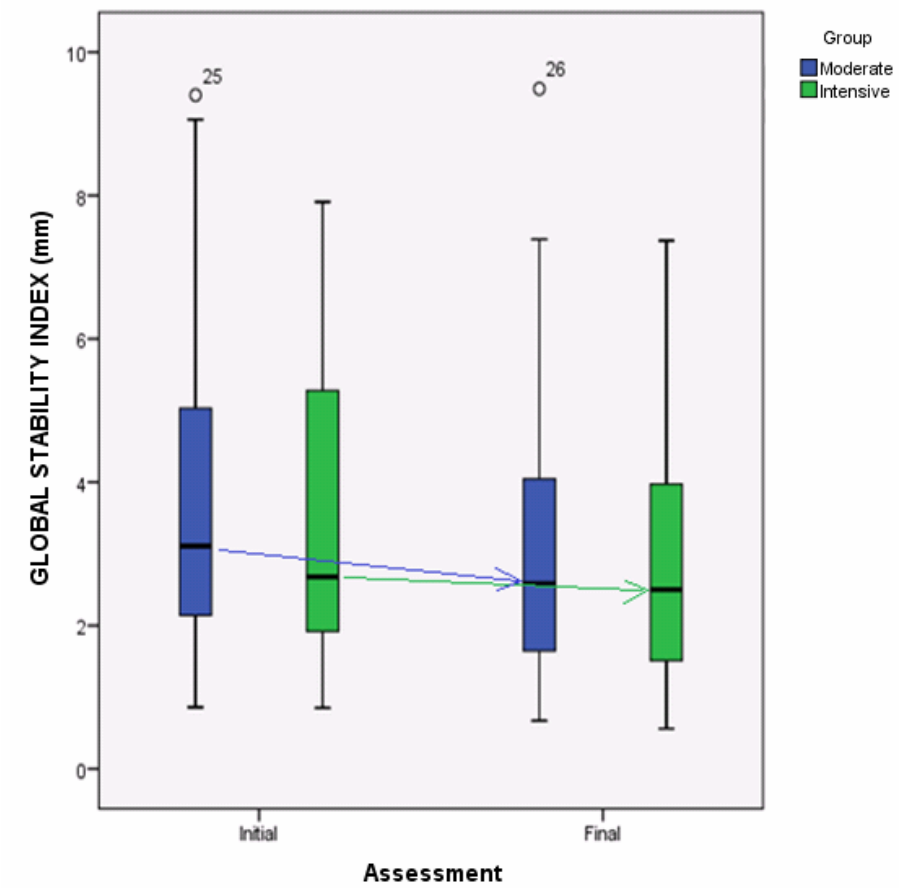


Figure 18. The box-plot diagram showing the data regarding the GSI data for the two study groups at the time of the assessments: initial and final.

To be re-emphasized that, praiseworthy, the NTCNRCNR has an accentuated and sustained augmentative dynamics of its endowment with ultramodern Physio-/ Kinesio-therapy equipment, so that in the last years, almost all our patients benefited (not in the standardized methodological method that we applied and followed systematically at the level of the two study groups, but still, supplemented by the administration of different physiotherapy newer procedures) in addition to kinesiotherapy; therefore, this was the only available control group – because it had performed only physical kinesiotherapy and was also evaluated by the GMFM scale.

Apart from this advantage, however, there is the disadvantage/ limitation of this study of the age difference between the patients of this "control" group and those of the other two groups (the study ones), namely the average of the control group is about half the average of the other groups. This explains in particular the statistically significant difference between the mean values on the GMFM scale, between the control group and the two study groups, at the initial assessment.

Gross Motor Function Measure GMFM66 – at initial assessment

From the histograms related to the GMFM66 data – at the initial assessment – in the three groups, it is found that there are apparent deviations from normality. But the Kolmogorov-Smirnov normality test produces p-values of 0.089 attached to the "Witness" group, of 0.218 attached to the "Moderate" group, and of 0.133 attached to the "Intensive" group. Only one of them is above the threshold (0.20) of accepting normality, but none of the three is below the threshold (0.05) of categorical rejection of normality. Therefore, we were able to compare the groups by the (parametric).ANOVA test.

Table 10

The main descriptive statistical data related to the three groups (initial assessment)

Descriptive

GMFM66 - Initial

Group	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Control	89	**54,0262**	15,47648	1,64050	50,7660	57,2863	32,31	82,99
Moderate	40	**67,1625**	13,15300	2,07967	62,9560	71,3690	46,90	86,50
Intensive	34	**69,9441**	12,82439	2,19936	65,4695	74,4188	45,90	92,10
Total	163	60,5701	16,06114	1,25801	58,0859	63,0543	32,31	92,10

Table 11

Result of the ANOVA test, initial assessment

ANOVA

GMFM66 - Initial

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	8537,282	2	4268,641	20,539	**,000**
Within Groups	33252,292	160	207,827		
Total	41789,574	162			

It is observed the standard deviations have values 12.82 – 15.48 and that the mean of the GMFM66 values – at the initial assessment – for the "Control" group is apparently lower than the mean of the values for the "Moderate" group, which is lower than the mean of the values for the "Intensive" group. The 95% confidence interval that frames the mean for the "Control" group (which is 50.76 – 57.29), is disjoint from the other two 95% confidence intervals, which are 62.95 – 71.37, respectively 65.46 – 74.42 (these last two confidence intervals not being disjoint in between).

The ANOVA test attached a p-value <0.001 to the statement that "group averages differ significantly from each other".

To compare the groups between them, using the Post-hoc Tamhane test (adapted to the situation where the standard deviations are not approximately equal), we obtain that the (negative) differences of -13.14, respectively -15.92 between the mean of the "Control" group and the means of the others two groups are statistically significant (p <0.001) but the negative difference of -2.78 between the means of the "Moderate" and the "Intensive" group is not statistically significant (p = 0.739).

GMFM66 – at the final assessment

From the histograms related to the GMFM66 data – at the final assessment – in the three groups, it is found that there are also apparent deviations from normality but the Kolmogorov-Smirnov normality test produces p-values of 0.086 attached to the "Control" group, of 0.259 attached to the "Moderate" group, respectively of 0.183 attached to the "Intensive" group. These p-values are similar to those produced at the time of the initial assessment. Therefore, even now we will be able to compare the groups by the (parametric) ANOVA test.

Table 12

The main descriptive statistical data related to the three groups (final assessment)

Descriptive

GMFM66 - Final

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Control	89	**54,6120**	15,59927	1,65352	51,3260	57,8980	32,31	82,99
Moderate	40	**73,2250**	14,07081	2,22479	68,7249	77,7251	51,30	92,10
Intensive	34	**76,3029**	14,71131	2,52297	71,1699	81,4360	50,60	100,00
Total	163	63,7041	18,02898	1,41214	60,9155	66,4927	32,31	100,00

Table 13

Result of the ANOVA test, final assessment

ANOVA

GMFM66 - Final					
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	16380,011	2	8190,006	36,122	,000
Within Groups	36277,134	160	226,732		
Total	52657,145	162			

Table 15

Results of LSD post-hoc test

Multiple Comparisons

Dependent Variable:GMFM66 – Final

	(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
LSD	Control	Moderate	-18,61298*	2,86633	,000	-24,2737	-12,9523
		Intensive	-21,69092*	3,03581	,000	-27,6863	-15,6955
	Moderate	Intensive	-3,07794	3,51239	,382	-10,0146	3,8587

* The mean difference is significant at the 0.05 level.

It is observed that the standard deviations are approximately equal (values 14.0 - 15.6), that the mean of the GMFM66 values – at the final assessment for the "Control" group – is apparently significantly lower than the other two means, and the mean of the values for the "Moderate" group is lower than the mean of the values for the "Intensive" group. The 95% confidence interval that frames the average for the "Control" group, of 51.32 – 57.90, is disjoint from the other two 95% confidence intervals, which are 68.72 – 77.73, respectively 71.16 – 81.44, these last two confidence intervals not being disjoint.

The ANOVA test, attaching a p-value <0.001 to the statement that "group averages differ significantly from each other", confirms it.

Table 14. For the comparison of the groups between them, using the Fisher's Least Significant Difference (LSD) test of Post-hoc type (adapted to the situation where the standard deviations are approximately equal), we found that the (negative) differences of -18.61, respectively -21.69 between the average of the "Control" group and the averages of the other two groups are highly statistically significant (p <0.001) but that the negative difference of -3.08 between the average of the "Moderate" and the "Intensive" group is not statistically significant (p = 0.382) – see Table 16 below.

Evolution on the GMFM66 scale

Regarding the analysis of the evolution of GMFM66 values between the two moments, initial and final, for each group separately, the (almost) normality of the data, previously found, allows the use, for comparison, of the (paired) t-test.

For all groups the p-value calculated by this t-test is <0.001, which means that the improvement in GMFM66 values is highly significant.

But in the control group this improvement (initial – final evolution) is, on average, only 0.59 and in the other groups it is significantly higher, over 6, more precisely 6.06 in the "Moderate" group and 6.36 in the "Intensive" group (see Figure 19 for an illustration, however based on the medians).

Therefore, the effect size of the treatment can be evaluated as having the value of at least 6.06 – 0.59 = 5.45 (points on the GMFM66 scale).

Pediatric Balance Scale (PBS)

PBS – at the initial assessment

From the histograms related to the PBS data – at the initial assessment – in the two study groups, it is found that there are deviations from normality, plus the obvious lack of homogeneity in both groups. The Kolmogorov-Smirnov normality test produces a p-value of 0.014 attached to the "Moderate" group, respectively 0.069 attached to the "Intensive" group. Both being below the threshold (0.20) of accepting normality, the first being just below the threshold (0.05) of rejecting normality, we could compare the lots by non-parametric tests.

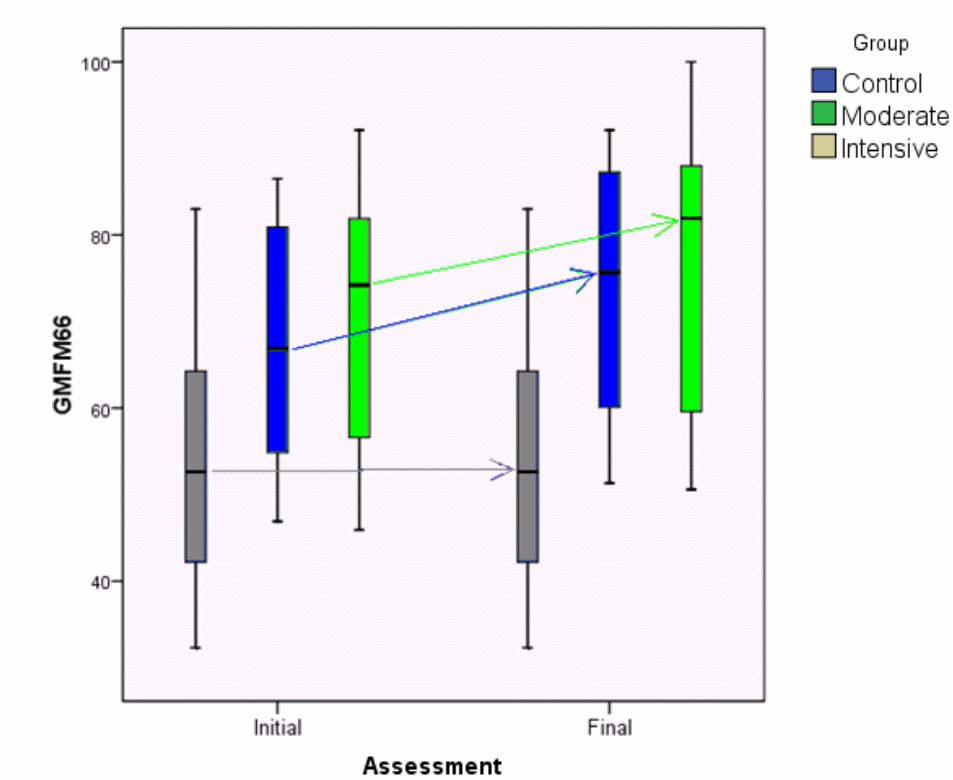


Figure 19. The box-plot diagram showing the data regarding the GMFM66 data for the three groups at the time of the assessments: initial and final.

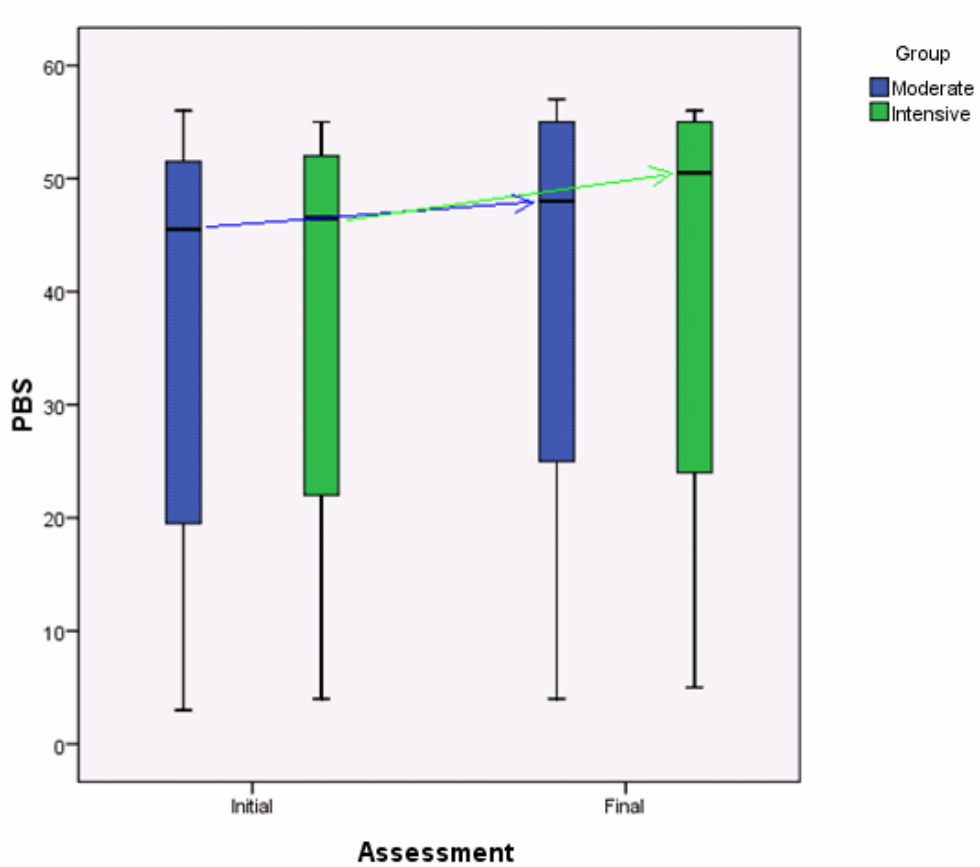


Figure 20. The box-plot diagram showing the data regarding the PBS data for the two study groups at the time of the assessments: initial and final.

The Mann-Whitney test uses for comparison the averages of the values of the values from the two study groups (assumed in ascending order); In our case these two averages are almost equal: the p-value produced by the M-W test is 0.970, close to 1, so that, from a statistical point of view, the data of this type in the two groups are similar.

PBS – at the final assessment

From the histograms related to the PBS data – at the final assessment – in the two study groups, it is found that there is also in this final assessment, there are deviations from normality and an obvious lack of homogeneity, in both study groups. The Kolmogorov-Smirnov normality test produces a p-value of only 0.026 attached to the "Moderate" group, respectively 0.017 attached to the "Intensive" group. Both being below the threshold (0.05) of rejection of normality, we compared the lots by nonparametric tests.

The Mann-Whitney test, using for comparison the averages of the ranges of values in the two study groups, produced a p-value of 0.858, close to 1, so that statistically, the two groups are similar, in terms of this parameter and the final.

To compare the evolutions of the PBS parameter within each group, taking into account the previously found non-normality of the data, we used the nonparametric Wilcoxon (Mann-Whitney) test.

For the "Moderate" group, it produces the value $p < 0.001$, which indicates that the PBS values – at the final assessment are significantly higher than the PBS values – from the initial assessment, in this group.

For the "Intensive" group, the results are similar to those in the "Moderate" group.

Apparently, the "Moderate" group has a weaker evolution, the PBS values increasing more in the case of the "Intensive" group. However, there are no statistically significant differences between the study groups, neither at the initial assessment, nor at the final assessment, the evolutions from both groups, increasing being statistically significant ($p < 0.001$ for both study groups).

DISCUSSION

Aside classical kinesiotherapy, the patients in the study lots/ groups benefited from the facilities for clinical-functional and posture assessment, and training, of the high-performance apparatus: Prokin 252 (device for analysis and training of static and dynamic balance, aiming at improving the control and coordination of the body, cognitive and proprioceptive stimulation) and respectively, GEO (robotic system that helps patients by supporting the correct movement in both: walking and in more complex activities such as going up and down stairs). The GEO device helps to correct movement patterns including, possibly, with an associated immersive virtual environment – with double task – by applying 3D virtual reality glasses.

The patients within the study lots/ groups also benefited from training sessions with the MYRO apparatus– this technology provides an interactive therapy surface with motion and pressure sensors, for the training of daily activities (fruit picking, removal of raindrops) unilaterally and bilaterally, the interaction of hands (gestures) speed of reaction with hand pressure on the appearance of various geometric shapes on the screen – and NIRVANA (therapeutic system equipped with an infrared camera that recognizes and analyzes body movements thus creating interactivity through direct and spontaneous action in an augmented virtual setting with a portfolio of 60 exercises at different levels of difficulty).

We found the new standardized methodology of rehabilitation treatment (diversified and augmented, as described at the beginning of this article) produced beneficial effects, clearly superior – including as a difference between initial and final assessments – in the study lots/ groups, compared to the control one.

At the same time, in the study lots/ groups, statistically significant beneficial differences were objectified – between the initial and final evaluations – for most of the parameters: Ellipse area (including in favor of the "Intensive" dose procedural mode), in OE and CE situations, respectively Standard torso deviation, in OE and CE situations (in favor of the "Intensive" dose procedural mode but with values below 1 degree), Average speed of the pressure center, in the A-P and partially the M-L directions, in OE and CE situations, (including also in favor of the "Intensive" dose procedural mode – but with values below 2mm/s – except for the M-L direction in CE situation: a reduction of almost 4mm/s), GSI (significant beneficial differences between the initial and final evaluations – yet with values less than 1 mm – but not between the dose procedural modes), and the same significant beneficial differences between the initial and final evaluations – but not between the dose procedural modes – has been observed for the PBS.

From a practical, interventional, perspective, based on the actual partial results, in favor of the therapeutic – rehabilitation "Intensive" dose procedural mode advocates the differences in benefit – in most of the parameters assessed: better than the outcomes obtained with the "Moderate" dose procedural mode – as instrumentally and statistically objectified (according to the above presented results) but quite difficult to be observed clinically.

In favor of the therapeutic rehabilitation approach of "Moderate" type argues that it is a less demanding approach and therefore more accessible to both patients and relatives.

CONCLUSIONS AND PERSPECTIVE DIRECTIONS

These complex partial results allowed us an exhaustive and in-depth knowledge, both of the modern possibilities of objectification and of the clinical-functional response (with refined, precise apparatus objectification of fineness) to two types ("Moderate" and "Intensive") of rehabilitative treatment: complex, diversified and with increased beneficial effects in approaching balance disorders, in adolescents with PC, in an attempt to pragmatically establish, as well as possibly argued and objectified, which of the two dosage variants is preferable.

It is necessary to continue the study on larger lots/ groups, in order to increase the statistical power, as a prerequisite of even more reliable results.

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CONFLICT OF INTEREST

The authors have no conflict of interest.

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ANNEX I

Description and application of classical kinesiotherapy (by:
Constantin Florin Drăgan, Liliana Pădure – Metodologie şi tehinici de kinetoterapie. Editura Național, 2014)

CONVENTIONAL METHODS	OBJECTIVE	EXERCISES
FNP	INCREASING JOINT AMPLITUDE	RELAXATION-OPPOSITION(R.O.) "hold-relax?variant I - for hypertonic antagonistic muscles and Variant II - for hypotonic muscles. Isometry is done at the point of limitation of movement, after holding for 5-8 seconds at maximum intensity after which relaxation is required. RELAXATION - CONTRACTION (R.C.) - is performed in the case of hypertonic musculature. In the movement limitation area, isometry is performed on the hypertonic muscle at the same time as isotonia on the entire range of motion of the afferent joint.
KABAT	MUSCLE TENSION	Patient in supine position with upper limb above head in abduction 30°, pronated forearm, arm in external rotation, fingers extended and abducted, fingers and hand flexed, forearm supine, abduction of arm with internal rotation followed by flexion and opposition of the thumb.
KABAT	MUSCLE DISSOCIATION	From supine position, the patient's arm describes a diagonal movement - throwing an object over the opposite shoulder watching - the physiotherapist opposes the resistance and corrects the uncontrolled movements.
KABAT	MUSCLE COORDINATION	From supine position the patient performs the bottom-up movement of the lower limb, the knee in extension, gradually doing the extension of the fingers-dorsiflexion foot-supination leg, adduction-flexion-internal rotation of the thigh.
FRENKEL	CONTROLLED MOVEMENT	From supine position, the patient performs hip-flexion / extension movements, following the execution with his eyes - with indications for starting and stopping at key points.
FRENKEL	ACQUISITION OF ABILITY	From supine position, the patient leads the heel in the middle of the contralateral tibia - then it is raised and placed next to the leg followed at the end of the extension.
BOBATH	ACQUISITION / TRAINING OF BALANCE	The patient in orthostatism on the balance plate - the physiotherapist prints lateral movements with the effect of translating the pelvis from the right hemibody to the left one.
KENNY	NEUROMOTOR REHABILITATION	Passive movement of the affected / paralyzed limb will perform flexion and extension jerky for 3/4 seconds to determine muscle contraction - followed by a break of 5 seconds, then resume the exercise with 10 repetitions with concentration and follow the correct execution.
MARGARETH ROOD	BALANCE TRAINING	The patient in an orthostatic position - on the balance plate, by means of the pressure applied at the foot plantar level - follows and moves the center of pressure in simple directions (antero-posterior and middle-lateral) or complex (diagonal / octagonal) - from static conditions (when the balance plate is fixed) or dynamic (when it moves).
MODERN TECHNIQUES FOR APPROACHING AND TRAINING STATIC AND DYNAMIC BALANCE	ABDOMINAL MUSCLE TRAINING (ABDOMINAL RIGHT / OBLIQUE) AND SPINAL (LUMBAR SQUARE)	The patient in an orthostatic position - on the balance plate, by means of the pressure applied at the foot plantar level - follows and moves the center of pressure in simple directions (antero-posterior and middle-lateral) or complex (diagonal / octagonal) - from static conditions (when the balance plate is fixed) or dynamic (when it moves).

ANNEX II

Synoptic panel of the evaluation/ measurements customized unitary protocol used in our clinical study and of the afferent results

Nr Crt	Meta Initiale	Vârstă (luni)	Sex	Topografie	Lot 1 - tratament moderat complex	Lot 2 - tratament complex intensiv	GMFM 66 Init	GMFM 66 Fin	PBS Init OE/CE	PBS Fin OE/CE	ARIA ELIPSEI O.E/C.E (mm₂ (testul Romberg) Init OE/CE	ARIA ELIPSEI O.E/C.E (mm₂ (testul Romberg) Fin OE/CE	DEVIATIA TRUNCHIULUI O.E/C.E (grade°)(testul Romberg) Init OE/CE	DEVIATIA TRUNCHIULUI O.E/C.E (grade°)(testul Romberg) Fin OE/CE
1	KQ	168	F	TETRA	70		50.80	54.4Q2		32	9904.29/1853.19	8172.29/1076.53	15.79/10.74	8.38/9.97
2	KW	156	M	TETRA		90	45.90	50.6932		38	1196.53/2899.45	937.64/793.71	2.93/3.29	1.41/2.00
3	KE	192	M	TETRA	70		46.9	51.309		11	1942.77/2678.43	1627.35/1017.61	3.36/8.32	4.01/3.57
4	KR	180	F	DI		90	52.10	65.040		42	3247.07/4780.52	2746.83/3361.37	2.83/2.98	3.77/3.40
5	KT	204	M	DI		90	74.80	81.9447		56	875.41/3377.73	373.94/1198.35	1.64/2.12	0.68/1.10
6	KY	156	M	DI		90	11.9	89.7441		53	1325.95/753.89	258.36/697.95	2.22/1.13	1.03/1.00
7	KU	156	M	DI	70		85.20	92.3151		56	144.46/340.67	100.71/203.53	0.10/0.09	0.73/1.21
8	KI	156	M	DI		90	11.90	92.1945		51	912.65/3049.39	777.72/1495.45	1.71/2.35	1.46/1.69
9	KO	168	F	DI		90	14.60	59.618		11	6290.20/1839.41	5021.48/444.88	7.59/4.23	6.27/2.06
10	KP	180	M	DI		90	73.10	80.9455		56	462.75/649.68	227.32/525.34	1.22/0.77	0.19/0.14
11	KA	156	F	HEMI		90	15.20	100.0055		56	455.64/1660.68	341.53/711.37	1.28/1.76	0.74/1.15
12	KS	156	F	HEMI	70		68.10	77.5944		48	2027.77/5352.97	1297.30/2443.96	1.93/2.59	2.39/2.66
13	KD	156	M	DI		90	10.30	55.9534		40	1524.44/3850.16	1017.71/2394.06	1.22/2.04	1.12/2.07
14	KF	156	F	DI	70		49.10	53.1480		43	773.96/1225.47	314.62/540.66	0.04/0.03	2.39/1.88
15	KG	156	F	DI	70		83.00	89.7532		54	389.80/1033.11	456.01/626.71	1.35/1.12	1.49/2.81
16	KH	156	M	DI	70		86.50	92.1633		55	593.19/1195.27	356.49/772.93	2.02/1.98	1.13/2.27
17	KJ	180	F	DI		90	74.80	84.3146		49	692.35/369.04	267.40/273.04	2.28/0.99	1.73/0.77
18	KK	156	F	DI	70		72.60	81.9435		39	1388.27/42107.76	2625.00/1192.79	5.14/7.04	1.43/1.33
19	KL	156	M	DI	70		77.50	83.0046		46	1480.67/3268.96	1210.21/2332.86	1.76/1.97	1.88/2.95
20	KZ	192	F	DI		90	77.50	83.069		56	2460.71/805.05	1063.27/1060.03	4.26/1.77	1.97/1.54
21	KX	156	M	DI	70		79.10	83.005		4	1333.62/1540.77	1371.80/1229.39	5.23/4.62	3.14/2.62
22	KC	180	M	TETRA		90	74.20	81.962		29	2316.72/3084.59	2258.30/2037.62	4.78/5.31	2.62/2.69
23	KV	180	F	DI	70		66.30	71.200		4	937.48/878.88	1049.46/480.55	2.31/2.54	1.23/1.28
24	KB	156	M	DI		90	53.10	58.103		23	3915.00/4507.73	1236.40/1326.40	3.90/3.77	3.13/3.09
25	KN	156	M	TETRA	70		56.40	60.63		5	5361.40/3339.89	3733.68/2947.17	10.21/11.32	9.71/10.87
26	KM	168	M	HEMI	70		57.30	62.707		48	331.24/1432.36	257.71/267.87	1.42/1.40	1.42/1.99
27	QW	192	F	DI	70		57.10	63.397		46	808.11/857.85	754.83/817.21	0.07/0.08	1.07/1.74
28	QE	156	F	HEMI		90	92.10	100.005		5	241.72/1369.87	203.34/718.63	0.60/0.98	0.99/1.15
29	QR	156	F	DI		90	55.60	58.60		5	2626.57/1933.05	1313.97/1082.76	7.31/5.74	4.89/4.02
30	QT	156	F	DI	70		50.10	54.4087		11	9336.31/6585.29	5011.89/5993.23	9.74/8.11	9.03/9.36
31	QY	168	F	HEMI	70		83.00	88.005		5	686.79/488.58	833.96/121.84	0.85/0.84	1.04/0.93
32	QI	156	F	HEMI		90	58.60	66.704		3	1702.42/2939.06	383.90/1295.75	3.47/3.43	1.79/2.12
33	QO	156	F	DI		90	83.00	92.101		5	4012.94/3553.57	1157.00/1374.55	2.12/1.42	1.15/1.37
34	QP	156	M	DI		90	72.60	88.001		5	991.52/2499.58	852.27/1684.33	2.86/1.95	0.99/1.88
35	QA	180	M	TETRA	70		57.30	62.401		5	5525.75/5416.52	3445.16/2680.14	4.74/4.86	5.10/4.64
36	QS	156	M	DI	70		86.50	92.1055		56	2721.82/4788.66	1377.00/1164.27	6.67/3.11	4.92/2.46
37	QD	168	M	DI	70		64.00	76.0085		47	1444.85/2101.60	788.29/2008.55	2.77/5.34	2.16/2.11
38	QF	156	F	DI	70		64.00	67.407		1	2446.23/3367.20	1598.31/3020.23	6.71/8.01	4.10/5.78
39	QG	156	F	DI	70		57.60	62.705		1	2279.37/2842.65	2178.87/1563.53	0.06/0.05	4.09/5.29
40	QH	168	F	HEMI	70		77.50	83.003		5	642.33/690.62	269.33/551.44	1.30/1.06	0.65/0.80
41	QJ	156	F	TETRA	70		51.30	56.902		1	3432.12/4592.86	1815.74/3092.09	2.97/4.10	3.09/2.31
42	QK	168	F	DI	70		52.90	60.40		1	4732.64/3457.43	4000.25/3733.61	5.00/4.98	5.66/5.70
43	QL	168	M	DI		90	81.90	86.502		5	886.08/424.50	492.13/189.81	6.33/1.02	1.69/0.53
44	QZ	204	F	DI		90	56.60	59.107		1	1191.74/765.54	772.96/524.69	8.21/9.05	6.47/4.97
45	QX	156	M	HEMI		90	73.10	77.504		5	1842.87/4212.27	663.29/1646.32	1.21/1.95	1.23/1.44
46	QC	204	M	TETRA		90	86.50	89.705		9	1591.10/1536.24	655.14/1116.51	7.46/6.11	6.63/5.57
47	QV	156	F	DI		90	67.10	69.6049		52	1458.37/2226.73	1154.16/1887.18	1.67/1.98	0.96/1.92
48	QB	156	M	HEMI		90	50.60	52.9035		56	616.15/1000.84	137.92/553.55	2.06/1.94	0.98/2.25
49	QN	168	F	DI		90	51.80	52.60		1	1854.93/5008.41	1638.90/2503.88	8.45/10.14	9.91/11.38
50	QM	156	M	HEMI		90	81.90	88.004		5	1052.70/2912.44	897.09/1188.41	1.82/2.88	1.52/0.94
51	ZQ	156	M	TETRA	70		51.10	55.101		4	586.70/1356.11	1563.25/1161.30	3.95/3.97	7.04/5.52
52	ZW	204	F	TETRA		90	53.90	58.804		1	2571.90/2633.35	920.71/1718.60	1.41/1.26	1.58/2.36
53	ZE	204	M	DI		90	78.30	86.5048		56	569.13/1194.61	435.34/615.02	0.84/1.62	1.11/0.81
54	ZR	156	F	DI	70		81.90	89.700		5	773.45/1172.12	713.38/889.74	1.98/1.68	1.46/1.36
55	ZT	156	F	DI		90	78.30	83.00			713.38/889.74	525.56/659.73	1.46/1.36	1.69/2.24
56	ZY	168	M	TETRA	70		64.60	68.505		4	1131.13/1856.77	902.50/1115.62	3.21/3.25	1.77/2.42
57	ZU	156	F	HEMI	70		53.10	56.405		5	1497.95/946.66	634.18/2051.26	1.97/1.57	1.17/2.74
58	ZI	156	M	HEMI	70		80.90	88.004		5	147.82/146.38	94.93/125.16	1.46/1.15	0.88/1.09
59	ZO	180	M	TETRA	70		80.90	89.70			938.83/538.77	388.15/277.03	4.18/3.16	3.39/2.70
60	ZP	156	M	DI	70		50.60	57.305		4	259.67/238.68	230.50/181.63	2.39/1.74	1.96/2.55
61	ZA	216	F	TETRA		90	58.80	64.003		3	2705.99/7017.99	2172.29/4076.53	8.33/9.97	6.72/9.75
62	ZS	156	F	DI		90	75.40	84.102		5	532.79/1076.49	655.29/922.00	1.63/3.16	1.60/1.63
63	ZD	156	F	DI	70		54.60	57.304		5	2063.65/5029.46	913.66/3801.08	2.05/2.32	1.57/1.85
64	ZF	168	F	DI	70		85.20	92.107		5	1474.23/3010.47	962.29/2751.67	0.07/0.6	0.7/0.4
65	ZG	180	F	DI	70		67.40	75.402		4	557.87/2755.05	501.67/1265.28	4.10/6.24	2.54/5.34
66	ZH	156	M	TETRA	70		76.70	85.203		4	177.81/125.32	92.15/143.05	0.87/0.91	0.47/0.72
67	ZJ	156	M	TETRA	70		71.20	80.002		5	721.68/1058.44	664.81/1002.20	1.78/1.19	1.65/1.12
68	ZK	156	F	HEMI	70		55.10	59.801		4	284.50/1163.45	128.63/1046.87	2.57/2.18	2.15/1.08
69	ZL	156	F	DI	70		80.90	86.505		5	1056.60/1624.93	794.52/1271.91	3.06/2.68	2.98/2.16
70	ZX	204	F	DI	70		69.20	79.101		5	2317.96/4506.37	1389.15/3859.00	5.18/4.98	4.30/4.09
71	ZC	156	M	HEMI	70		83.00	89.701		5	832.82/1865.12	585.06/1350.36	2.13/2.48	1.98/2.15
72	ZV	156	M	TETRA		90	75.40	84.1019		54	874.56/1314.39	343.99/1121.49	2.78/3.12	2.20/2.18
73	ZB	192	M	DI		90	74.20	80.0050		52	1525.88/5358.30	1237.23/3870.40	2.68/2.93	2.00/1.74
74	ZN	192	M	DI		90	83.00	89.7053		56	974.20/2757.05	795.25/2575.00	3.98/4.12	3.30/3.28

Nr Crt	VITEZA MEDIE A CENTRULUI DE PRESIUNE A-P(mm/s) (testul Romberg) Init OE/CE	VITEZA MEDIE A CENTRULUI DE PRESIUNE A-P(mm/s) (testul Romberg) Fin OE/CE	VITEZA MEDIE A CENTRULUI DE PRESIUNE M-L (mm/s) (testul Romberg) Init OE/CE	VITEZA MEDIE A CENTRULUI DE PRESIUNE M-L (mm/s) (testul Romberg) Fin OE/CE	INDICELE DE STABILITATE GLOBAL OE (mm) Init	INDICELE DE STABILITATE GLOBAL OE (mm) Fin
1	66.70/65.79	40.36/41.71	102.77/229.46	47.56/60.74	5.18	4.14
2	16.90/27.04	14.60/20.99	17.47/32.34	16.70/18.57	4.18	3.43
3	15.23/11.09	11.81/9.70	17.05/8.34	20.51/15.24	3.59	3.01
4	18.33/21.85	20.25/16.43	12.29/19.25	12.08/13.52	5.78	2.51
5	7.29/11.27	5.54/7.52	6.57/14.70	6.31/11.42	1.56	1.20
6	12.67/8.56	7.25/9.44	10.22/9.50	4.67/7.32	1.79	1.38
7	5.32/7.98	4.90/5.82	3.89/3.30	2.84/3.62	2.15	1.27
8	9.18/13.64	8.56/13.19	8.49/10.13	9.86/12.28	1.33	1.10
9	21.48/24.33	7.48/13.11	43.99/19.06	41.87/16.83	5.66	4.18
10	5.67/9.13	6.19/12.84	4.90/8.27	4.12/5.97	2.45	1.54
11	9.47/14.88	8.47/14.05	8.27/13.25	6.01/10.59	1.53	1.48
12	21.29/35.22	13.06/14.82	29.34/48.01	16.96/19.29	6.23	7.39
13	21.37/30.80	21.16/16.56	20.96/22.87	16.05/13.59	2.68	1.85
14	15.25/17.18	12.86/17.37	13.67/17.36	29.72/35.18	2.69	2.27
15	7.45/11.37	16.98/21.07	5.42/9.19	9.77/14.41	0.86	1.15
16	8.91/9.94	9.50/10.66	7.99/9.05	4.40/6.90	1.39	1.10
17	6.27/7.95	5.22/6.48	4.85/6.80	3.31/4.32	2.37	3.32
18	16.77/47.96	17.62/20.38	14.42/63.41	14.78/8.66	4.88	3.85
19	20.21/25.35	13.91/21.45	14.42/18.02	11.81/11.65	7.48	6.81
20	14.71/8.64	9.27/9.56	8.51/6.60	7.07/7.36	4.80	4.46
21	13.69/18.20	10.01/10.21	13.40/15.59	8.31/7.16	5.56	4.28
22	22.09/24.68	13.65/13.47	16.24/18.81	11.19/12.51	7.71	7.37
23	15.50/14.57	13.62/10.38	12.94/9.87	9.08/6.46	4.51	2.91
24	28.28/33.26	13.90/18.42	21.20/26.37	8.31/18.42	3.28	2.57
25	31.28/21.21	29.91/37.39	31.11/33.53	28.53/35.57	9.40	6.07
26	14.21/20.22	13.30/6.05	6.34/12.86	5.37/6.05	9.06	9.49
27	12.39/15.85	11.91/14.05	18.46/15.81	9.77/15.84	1.75	1.68
28	11.56/25.56	11.98/24.44	6.80/18.36	9.44/17.33	0.85	0.56
29	59.05/42.09	22.79/18.15	19.58/17.47	16.55/16.24	7.91	5.00
30	82.74/68.28	49.24/62.38	71.86/58.50	50.11/54.94	4.88	4.57
31	9.26/12.81	6.74/13.00	7.86/6.79	3.49/4.02	1.88	1.65

32	17.66/21.15	13.33/19.25	14.30/17.75	9.45/18.21	5.28	3.97
33	17.17/17.90	7.31/10.89	24.32/36.33	7.42/9.77	1.54	0.73
34	10.63/10.63	8.29/11.46	7.51/27.03	5.02/10.80	3.51	2.67
35	29.29/31.11	29.05/30.38	20.38/29.90	34.06/22.71	3.32	3.80
36	24.67/22.26	20.09/25.03	25.46/18.03	15.24/18.90	2.38	1.92
37	15.92/21.72	11.19/20.57	17.84/13.28	12.68/17.49	3.83	1.64
38	35.90/35.21	27.03/31.05	24.68/35.99	13.50/19.29	3.08	2.97
39	18.80/22.57	23.18/29.94	18.97/22.14	22.16/16.41	3.10	1.43
40	12.03/11.26	9.23/11.35	7.95/9.61	6.97/9.90	1.21	0.80
41	53.00/50.96	26.93/32.44	39.24/36.22	25.71/24.41	2.69	3.79
42	33.83/34.89	30.20/28.22	27.31/22.31	43.86/50.13	5.56	3.30
43	10.52/6.77	6.64/5.82	7.82/4.22	5.21/3.87	6.72	5.07
44	20.91/22.15	18.99/12.34	21.54/18.91	18.00/11.97	2.62	1.91
45	9.98/15.48	7.66/12.87	7.86/12.73	6.75/10.41	1.65	0.93
46	17.93/15.26	13.11/11.92	34.82/24.91	10.61/9.13	3.51	2.72
47	17.62/23.58	13.42/19.55	13.40/16.00	13.40/21.04	2.47	1.41
48	10.73/13.18	8.24/16.47	5.86/8.30	7.21.12.92	2.02	1.51
49	27.03/29.66	17.26/17.42	25.87/44.81	21.38/16.14	6.90	5.70
50	11.11/27.44	14.52/21.13	7.58/19.40	9.41/12.66	5.89	2.85
51	34.22/48.73	27.87/24.21	15.61/18.38	28.71/31.73	5.97	5.47
52	22.29/20.63	10.81/16.12	35.06/39.37	26.95/38.51	5.10	4.47
53	7.23/13.12	6.77/9.26	9.16/19.68	7.46/10.22	4.56	2.07
54	15.21/18.97	13.85/17.23	10.13/14.42	10.14/11.56	2.27	1.38
55	13.85/17.23	7.84/13.52	10.14/11.56	9.39/10.58	2.51	2.49
56	44.05/46.60	20.58/27.15	9.74/11.57	7.40/8.60	6.39	5.63
57	17.17/15.80	10.45/16.14	12.02/10.34	8.26/12.28	1.32	0.67
58	8.88/7.33	7.08/6.77	4.50/4.86	5.56/5.20	2.13	1.30
59	17.73/11.19	13.25/11.26	18.64/10.25	9.25/8.87	6.71	5.75
60	9.79/8.65	20.09/17.52	9.65/9.26	9.71/7.88	2.66	1.65
61	11.07/17.99	9.55/15.26	24.53/39.34	22.59/39.17	5.90	5.75
62	5.95/5.74	3.72/7.65	6.35/8.66	7.31/6.54	1.85	1.70
63	11.16/7.45	9.13/8.67	10.33/37.75	5.40/23.31	4.13	3.95
64	16.04/20.08	10.08/16.43	7.98/9.19	5.69/7.97	2.12	2.09
65	5.68/7.72	3.52/12.97	8.42/11.72	4.97/9.16	3.15	3.10
66	4.27/3.24	2.22/3.02	2.72/2.09	2.27/2.51	1.86	1.70
67	6.86/6.75	4.50/6.16	8.20/9.31	5.73/7.87	1.20	1.08
68	3.85/8.09	3.01/7.71	4.44/8.26	3.06/7.94	2.63	1.90
69	11.42/13.15	6.86/12.17	8.24/10.00	7.79/6.31	3.90	3.15
70	11.97/12.65	7.57/8.09	10.22/12.31	8.99/11.56	2.23	2.15
71	5.50/9.42	3.73/8.92	8.47/8.59	8.43/7.54	3.12	2.18
72	5.77/7.69	3.23/6.37	5.66/9.46	3.77/5.98	2.14	1.90
73	12.57/18.79	9.61/13.65	3.94/8.40	3.50/5.65	2.68	2.98
74	15.36/10.12	8.15/10.62	7.83/13.67	5.96/12.65	1.92	2.28