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SUMMARY

I. GENERAL PART

Morbidity due to cerebrovascular pathology is in a permanent exponential growth, affecting larger and larger population groups, most of them in the active period of life, at an earlier age.

Due to the complexity of modern life involving multiple stressors, cerebrovascular pathology becomes a concern in the health policy of all developed countries.

The impact of food and environmental factors, imbalances between intellectual and physical activity, conflicting states of various types and in different social and family environments through which the subject translates, is added to multiple situational stresses, causing exaggerated reactions from the body, felt at different levels: nervous, endocrine-humoral and vegetative, and later on effector level - mainly cardio-vascular.

The accidents and incidents that mark the evolution of cerebrovascular disorders concern us throughout their development: during the installation, during the constitution, but especially in the sequelae phases with which patients and therapists have to fight all their life.

In functional recovery, for a professional physical therapist, every hemiplegic patient represents a test. And in this context if most of the time the functionality of the upper limb presents gaps that we compensate more or less, the ambulation is a goal of the whole activity, because the chances of rehabilitation are generally much higher and consequently, the improvement displacement creates a much broader area of activity and even positive evolution for the subject.

In this context, my concern for finding the most effective combined methods for improving walking in hemiplegic patients is within the current general orientation, which ultimately aims at permanently increasing the quality of life of each patient.

Knowing the cerebrovascular anatomy of the brain is essential in recognizing symptoms, diagnosing and developing treatment in stroke. For a correct diagnosis of hemiplegia, due to its variable and poliform clinical appearance, a classification of these elements is required, depending on the location of the lesion.

The evolutionary aspect is conditioned by the specific etiology of the anatomical disposition of the lesion.

In relation to the pyramidal bundle, from the cortex to the spinal cord there are many formations whose involvement helps to diagnose the lesion.

Pathogenic classification

- ISCHEMIC STROKE - 85% of cases due to interruption of cerebral blood flow through thrombosis or embolism;
- HEMORAGIC STROKE - 15% of cases represent the rupture of some arterioles in a patient with HTA, a cerebral aneurysm or an arteriovenous venous malformation.

The physical kinetic program of functional recovery and improvement for post-stroke hemiplegic patients is structured on the following stages:

- I. Physical training program, decontracturant-antispastic electrotherapy plus functional stimulation of the skeletal glands, in order to balance the agonist-antagonist muscle groups.
- II. Hydrokineto-therapy program - with the use of the floating effect and the thermal qualities of the water (improving the elasticity coefficient of the periarticular structures) with the facilitated development of the kinetic program for the paretic hemicorp, mainly for the recovery of the gait and the improvement of the functionality of the kinetic chain of the lower limb.
- III. Electrical program for strengthening the balance between the flabby and spastic muscles, at each joint level and in the kinetic chain of the lower limb, in order to prepare the kinetic program.
- IV. Kinetic program in the room with the improvement of the general posture of the column, basin and pelvic balance - inferior member, with insistence on the inferior paretic limb, permanent improvement of the qualitative and quantitative parameters of the gait.
- V. Therapeutic massage for relaxation of the paretic hemicorphae, with insistence on the lower limb. Restoration period. The development of this daily step-by-step program is about 4-6 hours, with integration into the specific individual biorhythms, and respecting the chronology. [65]

General objectives:

- Improvement of spasticity - physical and drug therapy (eg Lioresal)
- Improvement of joint / muscle dynamics,
- Improve coordination in the activity,
- Functional impact: decision - action - result.

This work represents the realization of a cumulative work totaling 5 years, of which 3 years were dedicated exclusively to data collections for the lots that were the basis of the work. I hope that through the new results I can contribute with information in order to help and supplement the data of the international community of researchers and also to the implementation of new medical practices / protocols by promoting the results.

II. THE SPECIAL PART

In this research I used the conventional recovery program, a few tests to be able to track the evolution of patients and, of course, the VirtualRehab platform, which is the special part and the novelty in this thesis, but also in the field in which I work.

In the contemporary world, regardless of the geographical area analyzed (global, European, national or simply local), the cerebrovascular pathology becomes a concern through the social, family and financial implications.

Thus, this pathology occupies a leading place in the campaigns of the sanitary prevention policies worldwide, because the consequences of this pathology are often debilitating, affecting the capacity to work irreversibly and generating a large number of MPAs (days of work lost) or even death. Thus, it can be said that it is one of the most expensive pathologies, especially since it tends to affect people starting from the maximum productivity period and often going to near retirement age, also speeding up this process.

As scientific objectives are trying to find / develop new medical methods / protocols aiming at increasing the rate of rehabilitation, increasing the degree of personal functionality and decreasing the degree of assisted functionality, as well as optimizing treatment schemes and reducing the huge costs generated by this pathology.

The paper contains a detailed analysis of the gait and balance ratio for stroke patients and methods of improving the biological parameters aimed at improving their quality of life and the impact of their functionality relative to their parents.

We have analysed parameters such as: FS-36 quality of life questionnaire and biomedical tests such as: "Comfortable / physiological walking over distance 10 m ", " 10 m fast walking ", " 2 minute walking test "(which follows 3 parameters: speed, number of steps and distance traveled)," Weight Center "which follows the member's degree of deviation lower affected.

The research in this paper is applicable, because it follows / starts from the related studies that have shown the benefit of virtual reality in some pathologies, the application of these techniques in the medical recovery as a component of a complex treatment scheme.

The data obtained were numerical and qualitative. Numerical data were represented by age, BMI, stroke period, results of SF-36 questionnaires and quality of life.

Formulating the conclusions required the processing of both the results related to the comfortable walking, the fast walking, the number of steps, the center of gravity, the length of the step, the dynamic step, the distance traveled in 2 minutes, the number of steps in 2 minutes, as well as the results obtained with the help of Kinect device..

The tables on numerical data included descriptive statistics, respectively average, standard deviation, median, maximum value and minimum value.

The Shapiro-Wilk test was used in testing numerical data for normal distributions, the absence of normal data distribution indicating the need to use nonparametric tests (Wilcoxon rank sum, Wilcoxon signed rank) and Spearman correlation coefficient.

The qualitative data included the lot, the distribution of women / men, the environment of origin, the etiology of stroke and the associated pathology. The processing of qualitative data was done using the χ^2 test. The data in the tables were highlighted by appropriate graphs. We set the level of statistical significance to 0.05. Descriptive statistics, tests and statistical tests were obtained using the statistical programming language R (1).

Historical questionnaire description SF-36 (Materials and methods)

The shortened form of the Medical Outcome Study questionnaire comprising 36 points (SF-36) was developed as an indicator of health status in the general population. The test can also be used as a qualitative result in medical practice and research.

As a general instrument, the SF-36 was designed to be applicable to a wide variety of conditions. SF-36 is useful to monitor patients with single or multiple pathological conditions and to compare their status with that of the general population.

The main original contribution of the present work is represented by the use of the virtual environment through the VirtualRehab platform, which has been validated from the clinical perspective and certified at European level that complements the physical rehabilitation therapies for the patients with different degrees of physical disabilities. It uses Microsoft Kinect motion capture technology and the Leap Motion sensor to transform patients into virtual reality environments, where they interact in 2D and 3D environments.

The results of the study show how VirtualRehab can help improve the patient recovery process when implemented concomitantly with traditional therapy.

The qualitative data included the lot, the distribution of women / men, the environment of origin, the etiology of stroke and the associated pathology. +/- the beginning of the recovery, VR refers only to lot 2.

The study included 230 patients divided into two groups, as follows:

I - experimental 120, and II control - 110, average age 60-62 years, gender distribution 80% men and 20% women. From an etiological point of view, ischemic stroke approx. 60% and bleeding approx. 40%. Of the participants of both groups 80% have associated pathologies, the most frequent being high blood pressure.

The results and the evolution of the patients in the 10 days of treatment can be seen in the tables and graphs made by the statistics based on the information provided by tests and measurements. Significant results are seen in the parameters of the steps as number and speed, exactly what we aim to improve in hemiplegic patients. The tests and measurements were performed on the first and last day of treatment, precisely so that we can follow the evolution. In this interval, only the pilot group benefited from the VR program, and the results are seen in the tables provided by the statistics.

One of the main benefits of using the virtual environment such as VirtualRehab is that it offers patients a new way of training to perform a large number of repetitions of the movements needed to encourage neuroplasticity. VirtualRehab also offers a unique way to include constraint-induced motion therapy (CIMT) in the patient's rehabilitation program.

It also aims to improve the quality of life of patients with neurodegenerative, neuromuscular and cerebrovascular diseases, allowing them to work on the functions of the affected body and helping them to recover and improve their mobility, gait and balance.

III. FINAL CONCLUSIONS

Improving the practice of physiotherapy through impact analysis, as well as the feasibility of implementing modern techniques is a necessity in improving the quality of life occurring in cerebrovascular diseases.

The patients included in the study showed an improvement in the usual tasks of ADL (Activities of Daily Living), especially the degree of self-care, and the recovery of mobility and dexterity, in some cases even achieving socio-professional reintegration in the same field. activity or in other fields.

Through virtual reality, the patient less feels the difficulty of rehabilitation exercises, thus disappears the fear and inhibition induced by pathology, and the results appear much faster. Once these movements are acquired, they can be used in the long term.

I noticed that patients do not get bored during VR training; being an interactive game, it eliminates boredom and is much more fun for them this way of therapy.

At the same time, patients are focused only on the movement itself, without taking into account other physical and / or emotional barriers, thus increasing the ability to make the movement.

In combination with the basic physiotherapy sessions, the results are much better than if the patient would only perform classical physiotherapy. The patient performs an increased number of repetitions of the exercises without perceiving the physical and mental fatigue.

Virtual Rehab offers the possibility to implement the CIMT, through virtual reality using the lower limb in addition to the normal one. In other words, the patient is "fooled" by the system, is attentive to the action taken on the screen and forgets its functional impotence.

Further research would consist of implementing in all the recovery clinics and, at the same time, training the therapists to use the VirtualRehab program, and all stroke patients should benefit from the new rehabilitation method in addition to the conventional therapy. If the system were implemented in several centers, the VR program would allow the collection and storage of information from all the recovery units in an own database called ONEPREMISES, and then we would really have enough data to be able to track the evolution of patients over time and we could compare the long-term effects compared to the patients who only follow the classic recovery treatment.

The VirtualRehab system can be implemented in other health units, such as nursing homes, specialized centers for the treatment of Alzheimer's and Parkinson's, but it can also be used in recovery centers for children with various pathologies: autism, various forms of mental retardation whether or not accompanied by motor disabilities such as children with tetraplegias, paraplegia, etc.

The system is versatile, it can accompany any conventional recovery program, with the only condition that the patient can maintain his seated position and / or orthostatism, and the personal cognitive level will allow him to understand the visual and vocal commands.