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"Use of an Assistive Movement Training Apparatus in the Rehabilitation of Geriatric Patients"

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"Use of an Assistive Movement Training Apparatus in the Rehabilitation of Geriatric Patients"

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Abstract

While the birth rate in Germany stagnates on a low level for 30 years, the average life expectancy rises permanently [29]. That results in so called demographic changes which implicate a constant ageing of the population. This ageing process causes a shift in the morbidity spectrum with elderly people from acute to chronic diseases with multiple diseases. Since mobility is a significant requirement for quality of life in the old age, the influence of additional movement training (MOTOmed® movement therapy) on the walking ability of geriatric patients is examined by the presented assessment.
Study design: 21 patients (age: 80.7 ± 4.76) were chosen out of a test group of 42 geriatric patients by randomization to train with a MOTOmed® movement therapy trainer. During the in-patient stay of 3 weeks they should do a daily training of 15 minutes with the therapy trainer as an addition to the recommended rehabilitation interventions. The intensity should meet level 13 of the Borg Scale ("somewhat hard"). The influence of the MOTOmed® therapy on the walking ability and the endurance was measured through the 10m-Short-Distance-Speed-Test and the 2/6 Minutes-Endurance-Test. In addition to that a timed "Up & Go"-Test was conducted. The patients of the control group (n=21, age: 79.1 ± 7.49) received a conventional group therapy and a physiotherapy.
Result: The comparison of the test results before and after the intervention showed significant improvements in the walking ability in the group using the MOTOmed® [2/6 Minutes-Endurance-Test (p=0.006; p=0.000), Short-Distance-Speed-Test with fast pace (p=0.012), "Up & Go"-Tests (p=0.000)]. The averaged increase in power during the training sessions of 3.46 W (p=0,016) deduces furthermore to a growth of strength in test probands of the intervention group.
Perspective: In the rehabilitation of geriatric patients, the MOTOmed® viva2 movement therapy device contributes to keeping and increasing mobility, improving endurance and therefore contributing to every day life's independence, as well as increasing individual quality of life.

Key words: endurance, movement therapy, geriatric rehabilitation, walking ability, mobility.

Introduction

The negative influence on the walking ability and the walking pattern of illnesses associated to the age like stroke, Parkinson-Syndrome and diverse limitations at the brace and the musculoskeletal system is undisputable [7,13,23]. Not less undisputed is the fact that many malfunctions especially those caused by a lack of movement can be influenced positively through movement therapy [16, 19].
"Being able to walk properly again" is the one goal mostly expressed in rehabilitation from geriatric patients [26, 27]. In terms of the primary orientation of the rehabilitation process on resources of the geriatric patient in the first place it is aimed towards the quantity of the movement to first enable the overall transfer ability. The walking pattern was of secondary importance. The transfer ability and the walking ability associated to it were relevant to the success evaluation of the rehabilitation.
The present study was consciously focused on the daily motor activity of the lower extremities as a basis of mobility since it presents an essential rehabilitation element for obtaining independence, participation and lastly quality of life of the geriatric patients. Even though many patients are able to walk without assistance, a lack of walking pace and a strongly decreased endurance are causing further inactivity in the every day life [10].
Alongside widespread conventional rehabilitation methods such as physiotherapy, treadmill, ergometer training or hydrotherapy, a movement therapy with the MOTOmed® movement therapy system additionally represents an effective component in the in-patient rehabilitation of geriatric patients. It needs to be taken in consideration that the above mentioned therapy forms are not or are only partly applicable to many geriatric patients due to their limited motor skills. Given the chronical process of most geriatric illnesses one must consider that a continuous therapeutic patient care is often inevitable. On the other hand, with decreasing budgets of the health system and the increasing scarceness of resources, the MOTOmed® training represents a good alternative or at least a complementation in the in-patient as well as in the out-patient area. Therefore the clues need to be leading to the following question:
"Which influence does the motor assistive movement training have on the walking ability of geriatric patients during an in-patient stay?"
The success of the conducted geriatric rehabilitation methods is measured with the parameters mobility, walking pace and endurance and is evaluated accordingly by using acknowledged quantitative measurement procedures. The following study questions, deriving from and specifying the central issue, were formulated according to the object of investigation:

- Can additional MOTOmed® training improve the mobility of multi morbid geriatric patients?
- Does motor assisted movement training have any effects on the walking pace of geriatric patients?
- Can the endurance ability be improved within a specific time period by motor assisted movement training?

Patients and methods

The project was verified and approved by the ethics commission of the DSHS Köln. The patient recruitment, examination and intervention were conducted in the Prof. Selmair Wartenberg Clinic during an in-patient stay of the probands.
For the study a total of 44 participants were extracted who were required to meet the following **inclusion criteria:**

- Probands of the examination need to be patients of the geriatric rehabilitation
- Patients should be able to walk more than 10 meters/10.94 yards. (if required for applying diverse assistance tools)
- Patients should be able to rise from a chair and sit down again independently (with/without assistance tools)
- Patients should be cognitively able to train on a MOTOmed® and to follow the instructor's directions
- Patients should show interest and motivation in the study at least three weeks in-patient clinic stay

Exclusion criteria were defined as:

- Ability to train on a regular ergometer
  PAVK or NYHA patients of class III-IV
- Existing pain which does not allow for a training with the MOTOmed®
- Health condition that restricts training in the sub maximal area

Two of the accepted probands had to leave the study because of health and/or organizational reasons (transferring, discontinuation of therapy). Consequently the study material consisted of the data of 42 geriatric patients. After the randomization an intervention group (IG) and a control group (CG) were created, each consisting of 21 participants.

Group	Number (m/f)	Age (years) average ± standard divergence)	Number of physio-therapy/sport therapy exercises/day
IG	6/15	80,7 ± 4,76	1/4
CG	4/17	79,1 ± 7,48	1/3

Table 1: Patient data (IG = intervention group, CG = control group)

Procedure / tests

Sport therapy exercises have been designed to try to give all study participants similar group therapy exercises. The physical therapy exercises differ depending on the indication of the participating patients. The probands of the intervention group received MOTOmed® movement training in addition to the therapy plan. During the study the patients were all in the AHB rehabilitation phase.
To be able to make a statement about possible improvements of the walking ability and the mobility in the pre vs. post

comparison the following motor tests have been used before and after intervention:

- Timed -"Up and Go" -Test,
- Timed-Walking-Tests:
  - 10-Meter-Walking-Test (comfortable respectively fast walking pace)
  - 2- or 6-Minutes-Walking-Test

Timed-"Up & Go"-Test
The examination of the transfer ability in both groups (sitting-standing and standing-walking) occurred during the Timed- "Up & Go" Test [21]. Here, the covered walking distance is objectively assessed by time measurement, and the required time is documented in seconds. If the probands needed less than 10s for this test they were categorized as unrestrictedly independent [1].

Time-Walking-Test
The walking pace is a key indicator for a person's walking ability [7]. A healthy person can control the walking pace and adjust it accordingly to intern and extern conditions [18].

Even as a quantative parameter, presented in m/s or m/min, it gives direction about the quality of movement by getting information about the length and the amount of the steps. Therefore measuring the walking pace is an effective method "which allows studying both, the walking ability and the effectiveness of therapeutic methods" [7].

1. **10 m-Walking-Test**
   The Short Distance Speed Test, specified in 10 meters, is suggested assessment within the scope of the Motor-Functional Assessments, the so called MOFA-Scales [27].
   The 10 meter walking distance can be completed with an individual is comfortable pace and with an individual's maximum pace. The average of each measurement is recorded in m/s. They are allowed to use necessary assistance, which is recorded as well.
2. **2-or 6-Minutes-Walking-Test:**
   The Endurance-Test can be limited to 2, 6 or 12 minutes of walking time and evaluates the endurance ability of the patient [15]. By choosing his/her own pace and by using any kind of support, the patient is asked to walk a predetermined distance, usually 20 meters, back and forth, until given the command to stop [15]. The patient may pause as often as necessary if a decrease in performance or a sense of discomfort occurs.

Intervention

Every participant of the intervention group was asked to train once a day, for 15 minutes on a MOTOmed® viva2 movement therapy system, as additional therapy training for the in-patient stays. The movement system is a modified bicycle ergometer which allows even patients with walking disabilities or those who were unable to walk at all to carry out alternating movements of the legs from the wheelchair or a regular chair (see figure 1). Here you can do both cycle actively and let your legs be moved passively. The 15 minute exercise duration should always include a 2 minutes warm-up-respectively cool-down-phase. However these passive exercise phases could be left out depending on the health conditions of the proband and that way the active exercise duration could be extended to 15 minutes. An increase in the duration of the active exercise training according to one's endurance training was suggested and considered desirable [6].

Picture 1: MOTOmed® viva2 (RECK-MEDIZINTECHNIK (o.J., p. 20)

The training period was individually determined by the instructor depending on the therapy progress of the individual patient. The probands were asked to train with a cycle frequency of 50-70 revolutions per minute (rpm) while paying special attention to the symmetry display. The goal was to establish the activity of both legs and to train both legs with the same intensity. The initial workload was defined by the instructor according to load level 13 "somewhat hard" of the Borg Scale [3].
Furthermore, the exercise resistance at the beginning was determined by taking in consideration the individual fitness in reliance on the general condition. Exercise frequency, exercise duration, performance, distance, resistance, active and passive training phases and the data of symmetry training were documented after every exercise session.
During the intervention time the control group received the conventional therapy (group- and physiotherapy) similar to the intervention group.

Statistics

The statistical calculations of the motor tests were conducted by means of the statistics program "EASYSTAT V.3.4".
The significant level was chosen to be $\alpha = 5\%$ ($p = 0{,}05$). According to the motor tests the variance analysis was used initially. If significant interactions ($p<0{,}05$) between the intervention group and the control group appeared, a t-test for paired samples was performed.

Results

Although the motor skills within the groups varied strongly it was assumed that both groups were split up equally, meaning that before the examination period there were no significant differences between the intervention and the control group in terms of the patient characteristics (see table 1).

Time-Walking-Tests

The results of the Time-Walking-Test shown in the table below (10 m–Walking-Test; 2-respectively 6-Minutes-Walking-Test) represent a relatively equally spread out pre-test level in each test group although the performance varies strongly within the respective group. It is worth mentioning that the probands of the intervention group achieved worse results during the entry tests (see table 2). The intervention group showed in the 10 m–Test slower paces and covered in the 2- and 6-Minute-Walking-Test less meters than the control group.

Especially noticeable is the performance increase in the 6-Minute-Walking-Test. The probands of the intervention group walked on average 54,28 ± 36,38 m further than in the entry test and showed less volatility of the test values (from 230,30 ± 85,70 to 284,70 ± 70,22). In contrary, the control group stayed at its approximate entry level, however with a wider spread than in the entry test (from 242,14 ± 55,20 to 254,94 ± 60,65)(see figure 2).

Group	Invention group	Control group		
Test	Entry test (MW ± SD)	Exit test (MW ± SD)	Entry test (MW ± SD)	Exit test (MW ± SD)
10 m (comfortable) (m/sec)	0,76 ± 0,24	0,88 ± 0,23	0,80 ± 0,18	0,88 ± 0,18
10 m (fast) (m/sec)	0,97 ± 0,32	1,12 ± 0,31	1,03 ± 0,24	1,07 ± 0,23
2-Min.-Walking Test (m)	81,20 ± 27,50	98,90 ± 23,30	85,99 ± 19,36	93,33 ± 22,59
6-Min.-Walking Test (m)	230,30 ± 85,70	284,70 ± 70,22	242,14 ± 55,20	259,94 ± 60,65

Table 2: Time Walking Tests results of the IG and the CG in the pre-test and the post-test

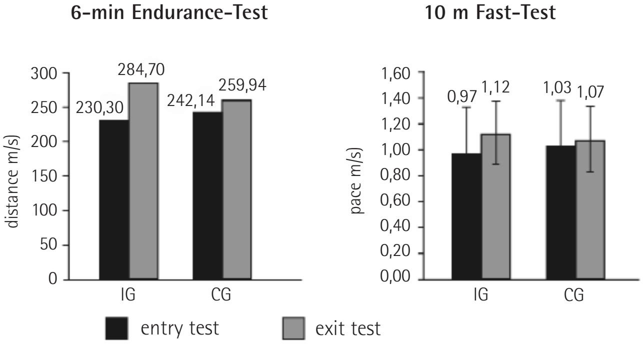

Figure 2: Result comparison 6-Min.-Test vs. 10-m-Fast-Test (IG= intervention group; CG = control group)

The subsequent variance analysis of the test data showed significant interactions in the Time-Intervention-Comparison between the two groups for the 10-m-Test (fast walking pace) and the 2- respectively 6-Min.-Walking-Test is significant. The test results of the variance analysis of the 10m-Walking-Test in comfortable pace were not significant and will therefore not be used further (see table 3).

Timed "Up & Go"

Figure 3 shows the results of the TUG-Test of the IG and the CG of the entry test and the exit test.

A development similar to the above mentioned test results is noticeable here as well: the intervention group was able to improve its time for the TUG-Test from 18,81 ± 9,52 to 13, 00 ± 4,99 with remarkable little standard divergence, while the control group achieved a noticeable smaller performance increase despite better entry values with 14,65 ± 4,10 s in the entry test and 13,76 ± 3,49 in the exit test. With the variance analysis of the results of the IG and the CG a highly significant interaction could be proven [see table 4].

The results of the above described analysis of the so called "simple effects" were examined afterwards. As shown in table 5 there are significant changes in the intervention group as well as partly in the control group.

MotoMed® movement therapy

The therapy compliance of the test group was very effective during the maximum 3 week intervention period with an average of 12 ± 2 exercise sessions of maximum 15 possible, as well as 12,95 ± 1,72 training minutes/session in which training actively. The collected data relate to the intervention group (n=21) during the whole therapy period of 3 weeks.

Training duration (active/passive)

Figure 4 illustrates average exercise duration (active/passive) of the intervention group for each therapy week. The probands trained actively on average 12,95 ± 1,72 min per training session, as well as 2,22 ± 1,65 min passively. Each intervention session was set on 15 minutes, and on average has been kept that way. At the beginning of the study (first week) the active duration was 12,21 ± 2,07 min on average, while the passive duration was 2,86 ± 1, 90 min. In the last week of exercise the probands trained an average of 13,55 ± 1,72 min actively and 1,68 ± 1,70 passively. The duration of the active exercise phase was significantly extended in the course of the movement therapy (according to t-Test with p=0,001), whereas the passive one was decreased as shown in figure 4.

Test	10-m-Walking-Test short distance speed	2/6-Minutes Endurance-Test
Test of the inner subject effects (∝ =5%)	comfortable: p=0,067 (ns) fast: p=0,012 (s)	2 min: p=0,006 (ss) 6 min: p=0,000 (hs)

Table 3: Walking Test significance in the Time-Intervention-Comparison (ns = not significant; s = significant; vs = very significant; hs = highly significant)

Test	TUG-Test
Test of the inner subject effects (∝ =5%)	p=0,000 (hs)

Table 4: Results of the variance analysis of the TUG-Tests (∝ =5%), (hs = highly significant)

Interaction	10-m-Fast	2-Min-Endurance	6-Min-Endurance	Timed »Up and Go«
entry- vs. exit-test IG	0,000 (hs)	0,000 (hs)	0,000 (hs)	0,000 (hs)
entry- vs. exit-test CG	0,398 (ns)	0,006 (ss)	0,011 (s)	0,304 (ns)

Table 5: Results of the variance analyse of the Time-Walking-Tests (∝ =5%), (hs = highly significant)

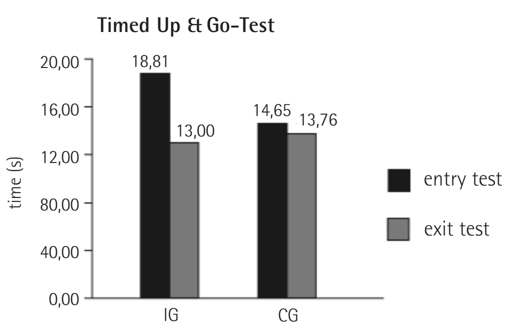

Figure 3: Comparison of the averaged results of the IG and the CG in the TUG-Test

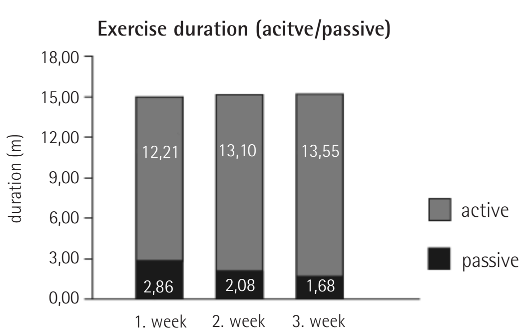

Figure 4: Averaged exercise duration (active/passive) per exercise session of the IG

Distance

Figure 5 overviews the covered distance of the probands during each intervention week. It consists of active and motor assistive covered distance. In the entire process the covered distance increased on average from 3025 ± 798 m (first week) to 3788 ± 919 m (third week) whereas the trade-off of this parameter is reflected by the actively and passively covered distance. The actively covered distance was extended highly significant in the entire process (with p=0,000) from 2708 ± 920 to 3578 ± 1058 meters while the passively covered distance shortened itself from 356 ±241 to 204 ± 229 meters. During the whole intervention time, on average, every participant actively covered a distance of 3195 ± 1024 m per exercise session.

The averaged performance – MOTOmed® performance measurement (wattage) deviates from a customary rotation speed independent ergometer – was increased from 10, 65 ± 5,62 W (first week) to 14,11 ± 6,87 W (third week) with significance of p=0,016 in the entire process of the study (see figure 6). The study participants trained for the whole intervention period with an average performance of 12,55 ± 6,30 W.

Since the achieved performance of rotation speed dependent devices is correlated to the parameters resistance and cycle frequency the following figure 7 shows the development of resistance. The relevant resistance can be read off by means of the gear illustration on the display of the MOTOmed® and was increased from an average of 2,9 ± 0,85 gears in the first week of the training to 4,3 ± 0,92 in the third week (see figure 7).

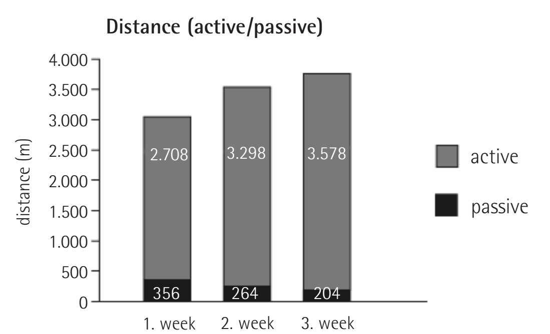

Figure 5: Averaged covered distance per training session of the IG

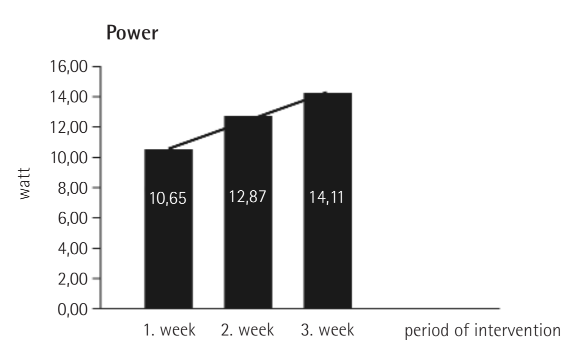

Figure 6: Averaged performance per training session in the IG

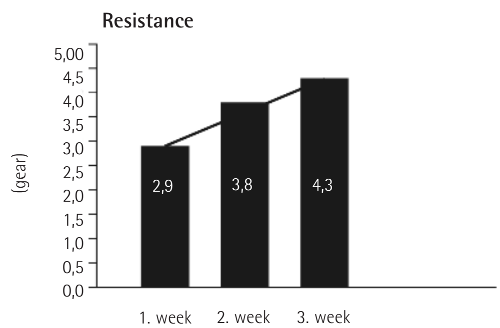

Figure 7: Averaged resistance per training session of the IG

Discussion

In this randomized controlled study, the additive effects of the training with a MOTOmed® movement therapy system during an in-patient stay of geriatric patients was evaluated. The duration of the intervention was set to three weeks, responding to the regular rehabilitation period. The therapy success was measured through pre- and post-tests which were carried out in therapy rooms of the Wartenberg clinic in order to achieve standardized conditions.

MOTOmed® movement therapy

Due to its positive effects on the cardiovascular system and the skeleton musculature of geriatric patients an ergometer based exercise is used both as a rehabilitative method and within secondary prevention. In case of limited mobility the ergometer is recommended for home use or its use in a sports club, especially being a gentle, risk-free alternative to walking, jogging or cycling in consideration of often existing morbidity [24]. Through the specified course of motion and the guided movements which represent basic advantages of the apparatus-supported exercises the risk of injury can be reduced and the course of motion can be simplified [30].

Considering the already evaluated therapy goal of an ergometer training this study examined the use of the MOTOmed® movement therapy device in an in-patient geriatric environment. One of the main goals of this clientele is the improvement of operational and social competence as well as of the behaviour leading to regaining of independence in everyday life. In this connection, the walking ability and mobility in general is very important. It can be assumed that endurance exercise of the lower extremities supports mobility and walking ability and therefore reaches sport therapy goals. Generally there were positive results in terms of walking ability in the neurological and cardiological rehabilitation with MOTOmed® viva2 movement therapy systems. [4, 12].

The training modalities must be evaluated considering the rehabilitation relevant peculiarities of an aging organism. Harmonic rhythmical courses of motion which correspond to the natural kinesic behaviour of elderly people and which are appropriate to the individual performance of disabled persons are suitable for a well-balanced movement training. The basic principle of geriatric rehabilitation – maximum effect with minimum risk – has always been considered during intervention in order to reach a training optimum. According to the motto: not for too long, but rather more often [28].

The decision about the duration of the intervention sessions is based on the knowledge of the cardiological rehabilitation research. On the one hand *Hollmann* (cp. *Rost* 1995, p.98) discovered in his researches that strains which last less than 5-10 minutes are impulse-effectless to the circulatory system [25]. On the other hand *Weineck* [32] argued in his publication that already 15 to 20 minutes of daily ergometer training is effective exercise.

Referring to the data of the probands the complete MOTOmed® training covered an average of 12±2 sessions during the intervention. A simple strain control with the Borg Scale was used by considering the argumentation of Borg that subjective strain sensation covers many important symptoms which, compared to the heart rate, is a constant and individual measurement even in old age [3]. For this study level >>13<< ("somewhat hard") was selected which is usually also recommended for moderate endurance training [3].

The patients adjusted the resistance to their individual ability so that they increased their performance in the previous week by an average of 3,46 W.

The features of the device enable a secure training of the lower extremities even with very limited mobility and coordination ability and it enables the patients to train effectively and also independently. Therefore the MOTOmed® offers a wide range of applications such as rehabilitation in the acute care, rehabilitation centers, specialized rehab training clinic, local medical care in rehab sport groups and for the patient's home use.

Discussion of the training results

The training course was adjusted to the physical possibilities of the geriatric patients and should correspond to the moderate endurance training in the sub maximum area. The training success was documented by the parameters "training duration", "distance covered" and "performance". During the course of the interventions all three parameters denoted a positive development.

The active training duration was extended by 8% and the actively cycled distance increased significantly by 26,1%. The increase of the actively cycled distance is therefore based on the expansion of the active training while decreasing the passive training. It is also based on performance increase during active training by increasing the revolutions per minute. The passive training was set between 40-50 rpm depending on the patients' condition.

The training performance consists of the cycle frequency and the adjustable resistance which ranges from gear 0 to 20.

According to the principle of progressive strain increase which is demanded corresponding to the suggestions for endurance training [6] the resistance was always adjusted to the individual performance increase. The training could be controlled with the Borg Scale so that the average performance could be increased during the whole intervention time with an average of 3,46 W. This equals a performance increase of approx. 32,5% (from 10, 65 ± 5,62 W in the first week to 14,11 ± 6,87 W in the third week) (p=0,016). Due to an increase of all three exercise parameters – duration, distance and performance – an overall improved endurance and an increased physical fitness was noticed in the intervention group. Despite the consistently growing performance, the members not only continued keeping the 15 minute training duration, but also increased the active training duration and the covered distance.

There are no comparable studies regarding the influence on this kind of movement therapy on the walking ability of elderly people. However the MOTOmed® movement training has become established in the rehabilitation of elderly stroke patients. Different examinations with movement therapy systems presented a positive development of the training data [12].

Discussion of the test results

Coordination, power and endurance are relevant parameters for motor performances. Weaker results of functional tests which are determined by locomotive abilities are predictive for walking disorders, dependence and momentous falls [9, 10, 14]. The functional tests which were used in this study primarily evaluate the above mentioned parameters. The rehabilitation progress is consequently recognizable by these test results.

Within this study, according to the agreed quality factors, the Time-Walking-Tests and the Timed-"Up & Go"-Test were accomplished to evaluate the therapy effects on the walking ability of geriatric patients.

As recommended by ***Green*** [8], based on her research with elderly stroke patients, the measurements of entry- and exit tests were conducted twice, whereas the average of both tests was used for further analysis.

That way, possible stress caused by being unfamiliar with the tests could be balanced in order to assure the validity of the Short Distance Speed and the Timed "Up & Go"-Test with elderly stroke patients.

The comparison of the results in the Time-Walking-Test as well as the Timed "Up & Go" Test discovered differences between the intervention and control group within their rehabilitative progress. In comparison to the entry test the participants of the intervention group improved their results in the 10 m Short-Distance-Speed-Test on average by 15, 5%, from 0,97±0,32 to 1.12 ± 0.31. The improvement is highly significant compared to the control group with an improvement of 3,9%, from 1,03 ± 0, 24 to 1,07±0,23. The variance analysis of the 10m-Walking-Test-performance with comfortable pace showed no significant divergence between the improvement of the IG with 15,8% (from 0,76 ± 0,24 to 0,88 ± 0,23) and the CG with 10,00% (from 0,80 ± 0,18 to 0,88 ± 0,18). Physical strain is necessary to show the actual endurance performance which should be the reason why there are significant differences between the two groups with fast rather than comfortable pace [17].

In the pre-post-comparison the results of the 2- and 6-Minute-Walking-Test showed significant to highly significant improvements of both groups (intervention group + 21,8% in the Distance Speed Test on average about 15,5%, from 0,97 ± 0,32 to 1,12 ± 0,31 in the 2-Minute- respectively 23,6% in the 6-Minute-Walking-Test, control group + 8,5% in the 2-Minute respectively 3,1% in the 6-Minute-Walking-Test). Compared to the MOTOmed® application, the conventional therapy showed fewer but more positive effects on the endurance of the participants. A comparison of the results of the 6-Minute-Endurance-Test with 'healthy people' which were examined in 1998 from ***Enright*** and ***Sherrill*** in a study with 290 adults, with an average age of 60,75 years shows the dimension of the walking impairment of elderly geriatric patients [5]. Based on the results of the 6-Minute-Test an average of 535 m was defined as standard. These values could not be achieved by the probands of this study, none the less because elderly people compensate decreased walking security by modifying their walking pattern. Although weaker patients basically experienced a better progress during the rehabilitation it can be concluded that the participants of the IG were able to walk more securely and therefore to walk faster than the participants from the CG at the end of the research period.

The walking pace is the most simple examination parameter which allows creating standardized conditions for exact and complete examinations of the walking ability. "It is physiologically and pathophysiologically the common final path, for many individual attributes and an independent variable for the measurement of many other parameters" [26]. Those can be kinetic respectively energetic parameters, posture or risk of falling. Locomotion is essential in handling everyday life tasks and requires a minimum pace. According to the literature the standard pace of a healthy adult up to the age of 60 is 1,4 – 1,5 m/s, of a healthy 70 year-old person its generally 1,3 m/s and a healthy 80 years old person walks with an average pace of 1 – 1,2 m/s [2,31]. Within this study those averaged walking paces with around 80 years old participants could not be confirmed. On the one hand this fact can be explained by the patients being in a rehabilitation phase, relatively shortly after a clinical stay. On the other hand, an intervention duration of three weeks is relatively short in order to gain a more significant improvement of the pace. Although a positive progress of the improvements of the intervention group's mobility could also be statistically proven with the Timed-"Up & Go"-Test. While the probands of the control group with 6% (14,65 ± 4,10 to 13,76 ± 3,49) could not significantly reduce their time requirements for the test. The improvement of the IG of 31% (18,81±9, 52 to 13,00 ± 4,99) was highly significant. The test is an adaptation of everyday

situations which for example imitates the getting up from the bed, from a chair or from the toilette linked to a walking distance and it evaluating the independency of the probands [11]. In this study the patients of the MOTOmed® group needed an average of 13,00 ± 4,99 s for the exit test and according to that they were categorized to be less mobile, however without limitations for everyday life [1]. It needs to be pointed out that walking dysfunction of geriatric patients caused by complex syndromes like Parkinson can not be analyzed with the Timed-"Up & Go"-Test since the typical symptoms do not show up until a longer distance is covered [20].
As shown in the following Table 6, there were large differences within the walking pace, the distance covered and the required time.

Test	Entry Test	Exit Test
10 m comfortable	0,28 - 1,32 m/s	0,53 - 1,31 m/s
10 m fast	0,47 - 1,64 m/s	0,61 - 1,71 m/s
2 min.	40,0 - 137,0 m	55,4 - 153,0 m
6 min.	82,2 - 421,3 m	163,3 - 440,8 m
Time "Up and Go" test	6,83 - 42,33 s	6,23 - 21,96 s

Table 6: Dispersion of the test results of the IG

As seen in similarly structured studies in the field of rehabilitation, in this study there is also a wide range of different influencing factors like the multimorbid physical condition which distinguishes specifically every single geriatric patient. This is a general problem in the geriatric research. As a reason for the deterioration of some probands – mainly in the CG – in the pre-post-comparison the meaning of the particular daily health condition can be emphasized.
According to the above mentioned test results the central research question can be approved.
In comparison to the control group the probands of the intervention group could improve their walking ability and independency in everyday life significantly by means of the MOTOmed® movement therapy after three weeks therapy.
When taking results of this study it must be considered, however, that positive therapy effects may not only be explained through MOTOmed® movement therapy since the technical assistive movement training happened in the scope of in-patient rehabilitation and only the combination of different therapy interventions lead to the desired progress.

Summary

Within the range of this study the question about the effectiveness of motor assisted movement training with geriatric patients during an in-patient stay should be elicited. For a period of three weeks 42 patients of the geriatric rehabilitation with an average age of 80,57 ± 5,27 who were able to walk took part in the research. By means of randomization 21 test persons were assigned to the intervention group and in addition to the conventional therapy they received a 15 minutes apparative assistive movement training, once a day. The resistance was controlled according to the Borg Scale to which the resistance level was adjusted to the subjective strain sensation of the probands. The intervention group showed significant improvements of their training parameters which were discovered by the movement trainer (see table 7).

Parameter	Improvement
active training	+ 8 % (s.s.)
distance	+ 23,6 % (h.s.)
performance	+ 32,5 % (s.)

Table 7: Summary of the training progress of the IG in percentage

At the end of the research period the participants of the MOTOmed® group were able to walk more securely, faster and further compared to the control group which was confirmed by the results of the motor skills tests.
The performance in the Time-Walking-Tests concludes to an improvement of the walking ability and increased endurance.
Without wanting to curtail the advantages of conventional therapies the analysis of the results indicates the MOTOmed® movement training as an effective and efficient additional therapy among sport therapy due to its functional operation. Therefore it meets the requirement >rehabilitation superior to nursing care < as an activating rehabilitation in the geriatrics. In the rehabilitation of geriatric patients the movement therapy system can contribute to obtaining and increasing one's mobility, to improving the endurance ability and therefore to the independence in everyday life which in return increases the individual quality of life. Due to short periods of intervention and the relatively small sample size the results of this study however can only be evaluated as a tendency. Therefore it is of preference to conduct further studies with a larger sample size and a longer period of intervention in order to be able to confirm those tendencies and results.

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