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WALKING PERFORMANCE OF PATIENTS WITH PROGRESSIVE MUSCULAR DYSTROPHY FOLLOWING USE OF A TILT TABLE

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起立台使用による筋ジストロフィー症の歩行能力

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要　旨

デュシャンヌ型の進行性筋ジストロフィー症児に対して起立台を使用すると歩行距離が著明に延長する。この要因を探るため，デュシャンヌ型5例と肢帯型2例に対して起立台使用，臥位における矯正板の使用，下肢関節の他動運動，および下肢の自動介助運動の4種の治療を施行し，比較した。起立台使用による歩行距離増加の最大の要因は足関節の矯正角度の大によることであり，起立台使用が足関節の矯正に最も効果的であることが判明した。

INTRODUCTION

Progressive muscular dystrophy (PMD) is a condition in which continuous muscular degeneration occurs, resulting inevitably in the loss of walking ability[1]. The latter seems influenced by such factors as a decrease in muscle strength, and aggravation of joint deformities, etc. There is no curative treatment for this condition, so that it is vitally important to maintain the walking ability as long as possible and, for this purpose, various exercise regimens and orthoses have been devised in the field of rehabilitation medicine[2, 3].

It has frequently been observed that some PMD sufferers are able to walk longer distances following a period of standing on a tilt table. This study investigates the above phenomenon and factors by which walking ability is influenced in PMD sufferers whose muscles are affected, but joint receptors or deep sensation are intact.

SUBJECTS AND METHOD

Seven children with PMD hospitalized in Ioh and Suzuka National Infirmaries par-

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Table 1. Subject data

Case no.	Type	Stage	Age
1	L-G	2	17
2	L-G	3	12
3	D	3	9
4	D	4	12
5	D	4	10
6	D	4	12
7	D	4	9

Table 2. Methods of treatment

1. Use of a tilt table
2. Application of corrective wedge boards
3. Passive movements of lower limbs
4. Active-assisted movements of lower limbs

ticipated in this study, of whom five were Duchenne (D) type and two limbgirdle (LG) type (Table 1). The former group consisted of one who was in Stage III of Ueda's classification of PMD and four in Stage IV, and of the latter group, one was in Stage II and the other in Stage III, respectively.

Four treatrmnt methods listed in Table 2 were used for all the subjects. Immediately after rising from bed in the morning each child was asked to walk as fast as long a distance as possible until he could no longer do so. The distance the child walked was measured while he rested for a few minutes. Subsequenct walking, followed by measurement, was repeated a few times. The child was considered incapable of walking either when he stopped, stated thet he could not walk any longer, or he leaned onto an object or on part of his own body.

Use of a tilt.table (TT method)

The child was stood on a tilt table with his chest and the lower part of his thighs fixated with straps, the angle of his hips and knees being in a position of maximum correction. His ankle joints were kept in the neutral position by inserting corrective wedge boards under his feet. The angle of the tilt table was 80 degrees and the child spent 20 minutes in this position.

Lying in supine with corrective wedge boards under the feet (LW method)

In order to eliminate gravity completely from the child's body the tilt table by the TT mehtod was lowered to the horizontal position and kept as it was with the child on it for 20 minutes.

Passive movements of the lower limbs (PM method)

One of the authors (KY) moved the hip, knee, and ankle joints of both the child's legs 50 times. The movements took place in the saggital plane and in the existing range only.

Active-assisted movements of the lower limbs (AM method)

As in the PM method, but the child moved his legs actively as much as possible with the physiotherapist helping the end range of movement if it was not completed in full existing range independently. The number of repetition was 50.

Each of these four different treatment regiments was carried out on a separate day, followed by measurement of the joint range of the knee and ankle.

RESULTS

Change in the walking distance

a) For LG group (Fig. 1)

Case 1 was in Stage II and case 2 in Stage III, both of whom were able to walk immediately after rising from bed in the morning. The TT method did not increase walking distance and it was found decreased in case 2. The LW method increased the distance slightly. There was hardly any change in distance with the PM and AM methods.

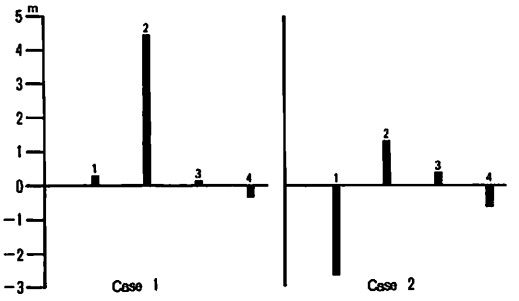

FIg. 1. Change in the walking distance of L-G groups.

b) For D group (Fig. 2)

In the cases 3 and 7 who were capable of walking immediately after rising from bed in the morning and the cases 4, 5, and 6 who were not, the distance increased considerably

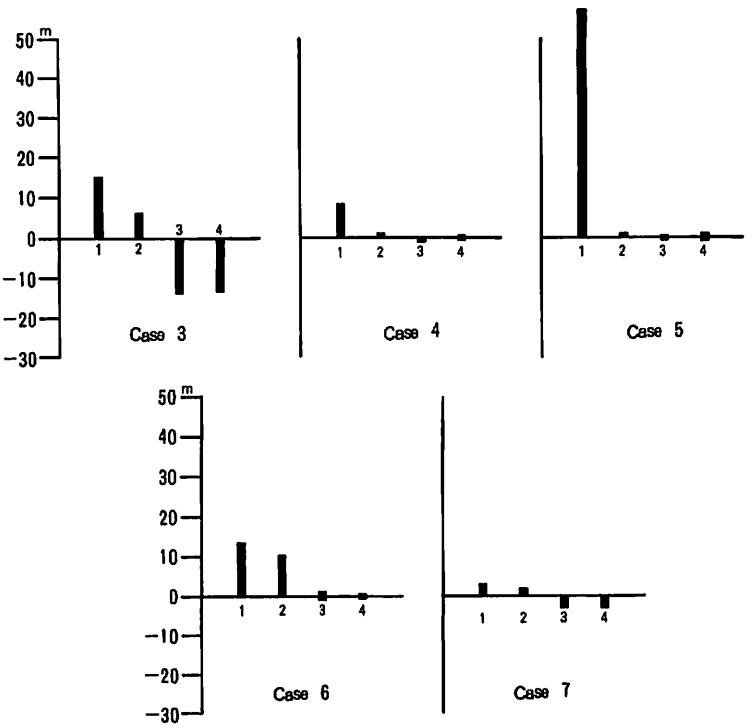

Fig. 2. Change in the walking distance of D groups.

by the TT method. Case 5 gained the largest increase, but there was little relationship to the severity of the condition. The LW method increased the distance, though the amount of increase was insignificant compared to the one gained by the TT method. The PM and AM methods were found not to increase the distance, but rather decrease it.

Change in the walking speed (Fig.3)

a) For LG group

As in the walking distance, the walking speed of case 2 was found not to increase, but rather decrease following the TT method. Neither the LW, PM, nor the AM method was found to increase the walking speed.

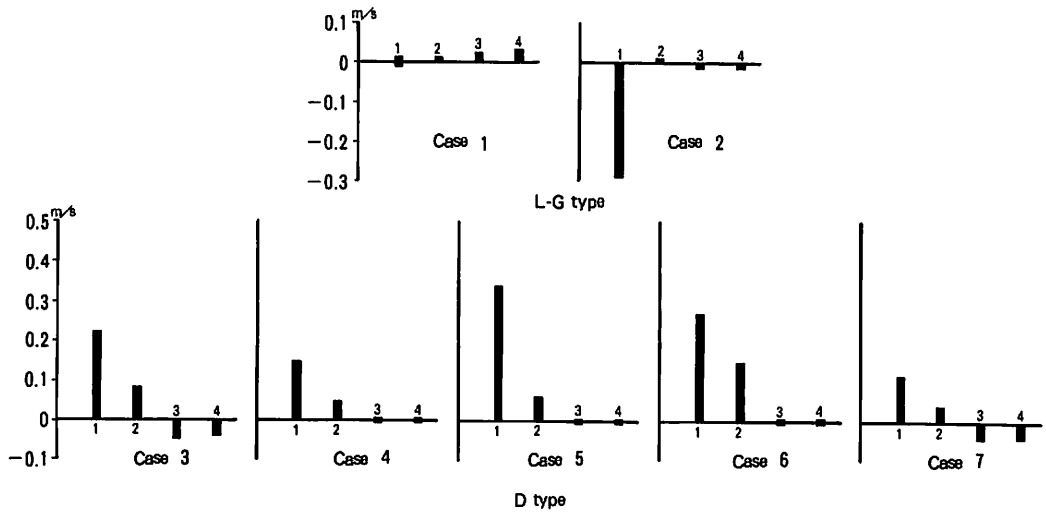

Fig. 3. Change in the walking speed of all sujects.

b) For D group

As in walking distance, the TT method was found to increase walking speed. The walking speed of cases 3, 5, and 7 following the TT method was larger than that of the LG group prior to the TT method. The LW method was found to increase th walking speed slightly in all cases. The PM and AM methods tended, as in walking distance, to decrease it.

Change in the range of movement

Figure 4 shows knee and ankle ranges of all the children in D group following the TT and LW methods. The range of knee extension was measured with hip flexion at 90 degrees and the range of ankle dorsiflexion with the knee extension. Both the TT and LW methods were found to increase the range of knee extension about the same, though the amount of increase in ankle dorsiflexion by the TT method was larger than that by the LW method. The hip range was not increased by the TT and LW methods. Both PM and AM methods were not found to change of range of movement.

DISCUSSION

PMD sufferers must not be confined to bed, as stated by Nojima[4], and standing and/or walking must be continued even though they have become wheelchair-bound. Loss of walking ability seems influenced by such factors as a continuous decrease in muscle strength, joint deformities, or because of psychological reasons. Because of this, various exercise regimens and orthoses have been devised in the past by many reseachers[5,6]. It has been frequently observed that walking distance is increased or walking ability is regained in PMD sufferers who had previously lost it completely, though there have been only a few published articles on this subject. Nedachi[7] and Niiya[8] have stated that standing on a tilt table prevents deformities of the lower limbs gives greater stability to the gait, and maintains walking ability. Accordingly, we employed four methods of treatment and compared LG and D types of PMD to answer such questions as 'How does gravity act on a child's body?' 'Does it act on the sensorimotor feedback system?', 'Does it act on joint receptors?', 'Is it affected by muscle stretch?', or 'Does it simply correct joint deformities?. This study, by choosing PMD sufferers whose all other systems but the muscular system are intact, might lead to a greater understanding of non-myopathic conditions.

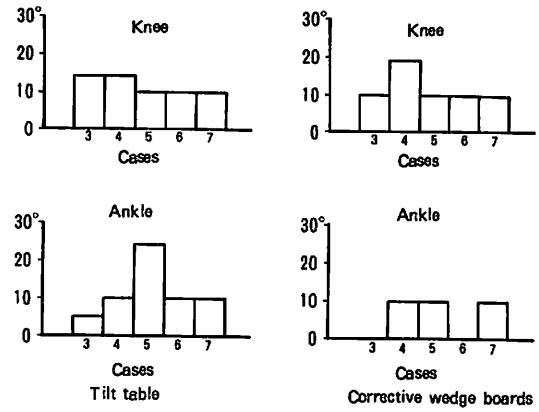

Fig. 4. Change in the range of the Knee and ankle joints.

Walking distance of the D group was increased following the TT mrthod; on the other hand, walking distance and speed of the LG group were not increased, but rather decreased. This fact not brought about by joint approximation[9] due to gravity. An increase in the walking distance of the LG group was larger following the LW than TT methods, which implied that fatigue was caused by gravity in the LG group. Muscle stretch in supine lying did not increase walking distance, but rather decreased it, which meant that the muscular contraction was not facilitated by stretch and fatigue set in.

The amount of correction of ankle deformity was larger in the D group with the TT method than with the LW or PM methods, though there was little defference in the knee with the TT and LW methods. Considering this and the increase in the walking distance of the D group the largest factor appears to be the correction of the ankle deformity. In addition, as we stated earlier, the TT method was found not to increase, but rather decrease the walking distance of the LG group. The walking distance of the D group was increased because the LW method, not the PM method, corrects ankle deformities. Kiyohara[3] has stated that the standing and walking ability of ambulant individuals must be maintained by preventing and correcting deformities, and the use of manual or mechanical traction should be used for this purpose. As has already been stated, the fact that non-ambulant individuals have become capable of walking following the TT method, or that walking distance has increased in ambulant individuals, suggests that an

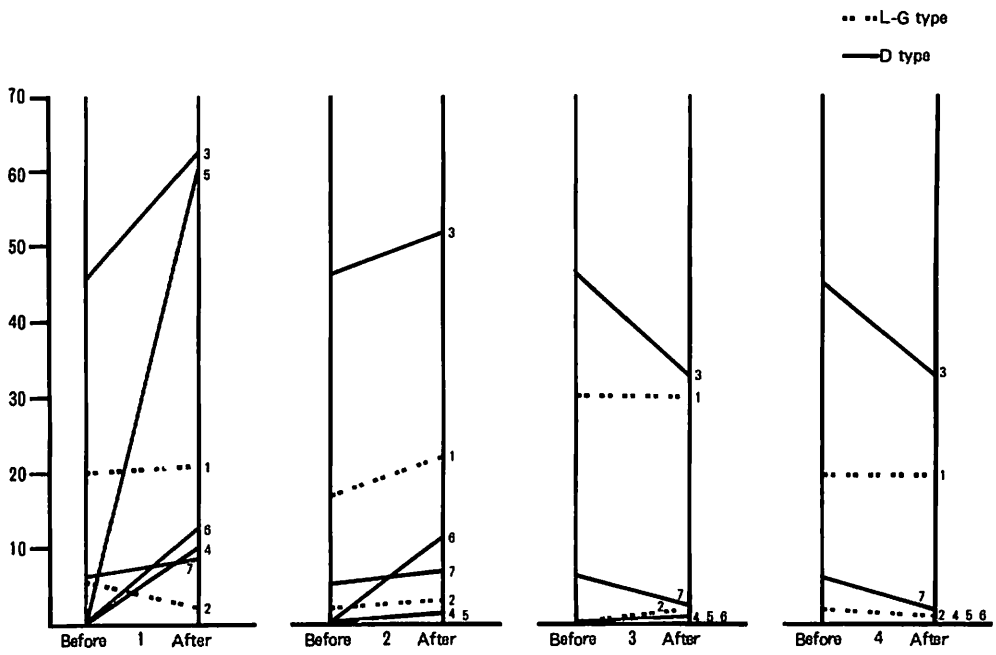

Fig. 5. Change in the walking distance.

increase in ankle range following the TT method was responsible. Because of this, it is correct to say that the result of our study is partially confirmed by Nojima's statement[10] that there are a few PMD sufferers in which deformities play a more important role than decrease in muscle strength. During our study walking distance gradually increased in 2 to 3 successive trials of walking. This had the same effect as using the TT method in that deformities of the ankles were gradually corrected by the action of gravity. Nedachi, et al. have stated that 20 to 30 minutes of standing is found to increase the walking speed most effectively[7].

In conclusion, use of a tilt table to stand children with the Duchenne type of PMD increased their walking distance. The largest factor for the above finding was the increase in the amount of correction of ankle deformities. Standing on a tilt table is the best method to correct this.

The result of our study is, however , tentative because of the small size of the sample. Date needs to be collected from a further sample of PMD sufferers to find out means of improving their walking ability.

SUMMARY

It has often been observed clinically that the walking ability of patients with Duchenne muscular dystrophy improves significantly following standing on a tilt table for a period of time. In order to find out factors for this phenomenon we employed four methods of treatment; standing on a tilt table, application of corrective wedge boards for the ankles in supine lying, passive movements, amd active-assisted movements of the lower limbs. The largest factor for the increase in walking distance was the amount of im-

proved ankle range following standing, thus, use of a tilt table was found to be the most effective in correcting ankle deformities, and resulted in a faster walking speed.

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