

The Effect of Gravitational Traction on Scoliosis of Duchenne Progressive Muscular Dystrophy : a Preliminary Study^{*)}

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ABSTRACT

Gravitational traction was firstly applied to five nine-year-old patients with Duchenne muscular dystrophy. They belonged to Vignos' class seven and eight. The traction was applied for ten minutes a day for one year. In two out of five cases application had to be suspended at the first and second month due to intolerance and vomiting, respectively. Cobb's angle became from 11 to 16 degrees in the tractioned cases and from 15 to 23 degrees in the suspended cases during one year, respectively. Spinal elasticity decreased by four percent in the tractioned cases and by 16 percent in the suspended cases, respectively. Vital capacity percent increased by three percent in the tractioned cases, but, decreased by five percent in the suspended cases, respectively. The number of cases in this study is too small and the period of follow-up is too short, but, the results suggest that the benefits of this gravitational traction are an improvement of respiratory function as well as maintenance of spinal elasticity.

INTRODUCTION

Respiratory distress in Duchenne muscular dystrophy is generally related to weakness of the respiratory muscles and to associated spinal deformities. This respiratory insufficiency leads to death in more than 80 percent of the cases. Despite the recognized seriousness of this condition, little information is available on a proper management of both weakness in the respiratory muscles and spinal deformity.

In our unique study, gravitational traction was applied to scoliosis in five children with Duchenne muscular dystrophy. The number of cases in this study is too small, but, a review of the literature shows that this may be the first attempt to apply gravitational traction to

this disease entity.

METHOD

Five nine-year-old patients with Duchenne muscular dystrophy were selected for this study. They belonged to class seven and class eight of Vignos²⁾ functional classification based on the ability to perform certain normal physical activity. Class seven children can walk in long leg braces, but require assistance for balance. Class eight children can stand in long leg braces, but are unable to walk even with assistance.

In gravitation traction the tilt angle was gradually increased up to the vertical position and the patients were held with head down by the pelvic girdle on our specially designed tilt

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table. The traction was applied for ten minutes a day for one year. X-ray examination was conducted every six months both in the sitting posture and in the head down posture. The angle of spinal curvature was determined by Cobb's method. Vital capacity was measured and vital capacity percent was calculated by Stewart's method for each subject every three months. During this traction the children were forced to respire as deeply as possible (Fig. 1).

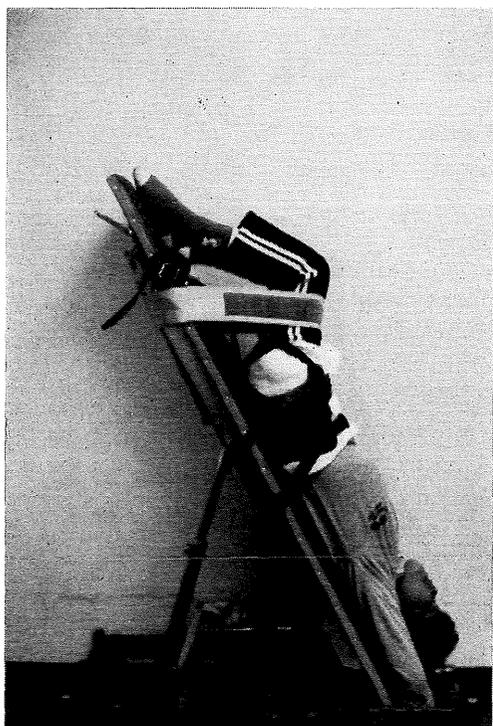


Fig. 1. Method of gravitational traction. Patient is put on our newly developed tilt table. The tilt angle is gradually increased up to the vertical position.

RESULTS

In two belonging to class seven and class eight out of five cases, application had to be suspended in the first and second month due to intolerance and vomiting, respectively.

1. Change of scoliosis

The initial angle of scoliosis for case K. S., T. N. and T. T. belonging to class seven was 7 degrees, 10 degrees and 15 degrees and the final angle of scoliosis in the first year after traction became 10 degrees, 16 degrees and 21

degrees, respectively. The increase of scoliosis averaged 5 degrees.

On the other hand scoliosis in suspended subjects became from 6 degrees in case S. N. and 23 degrees in case J. T. to 15 degrees and 30 degrees during the same period, respectively. The increase of scoliosis averaged 8 degrees.

2. Change of spinal elasticity

Spinal elasticity is plotted against the duration in days in Fig. 2. The degree of spinal elasticity was calculated by dividing the reduced Cobb's angle after gravitational traction by Cobb's angle measured in the sitting posture. At the initial time spinal elasticity was 71 percent, 88 percent and 95 percent in case T. T., case T. N., and case K. S., however, after one year of gravitational traction spinal elasticity became 88 percent, 82 percent and 73 percent, respectively. Spinal elasticity decreased by 4 percent in average during this period.

On the other hand spinal elasticity in the suspended subjects decreased from 93 percent

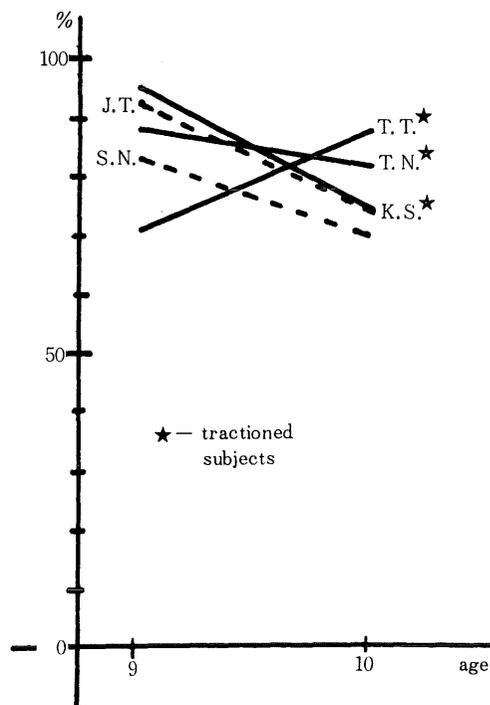


Fig. 2. Change of spinal elasticity. The degree of spinal elasticity is plotted against the duration in days. Black line indicates the tractioned subjects and broken line indicates the control. Case T. T. shows remarkable improvement of spinal elasticity.

to 73 percent in case J. T. and from 83 percent to 70 percent in ease S. N., respectively. The decrease of spinal elasticity averaged 16 percent (Fig. 2).

3. Change of vital capacity percent

Fig. 3 shows the passage of vital capacity percent during one year. Tractioned case T. T. and case K. S. show an increase of 12 percent and 3 percent in vital capacity percent, respectively. Only one case T. N. demonstrates a decrease of 5 percent in vital capacity percent. The vital capacity percent averaged 3 percent of increase.

In this figure two nine-year-old non-tractioned subjects are added to suspended case J. T. and case S. N. in order to increase the number of control. In the control the vital capacity percent averaged 5 percent of decrease during the same period as tractioned subjects (Fig. 3).

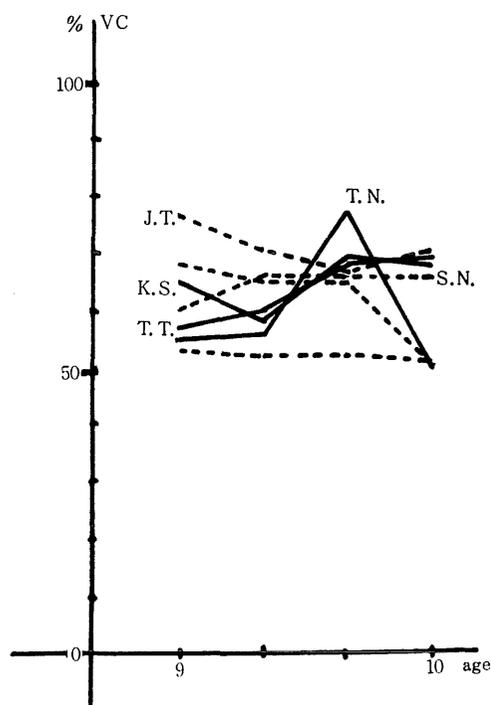


Fig. 3. Change of vital capacity percent
Vital capacity percent is plotted against the duration in age. Black line indicates the tractioned subjects and broken line indicates the control.

DISCUSSION

Some success has been achieved in stabilizing

the back and in decreasing the progression of scoliosis through Cotrel traction, bracing^{2,3} and spinal fusion surgery⁴. Tabjan⁴ used gravitational traction to prepare patients with idiopathic scoliosis for surgical treatment. According to his report, this method of hanging the head down not only softens both the scar and the related muscles but also increases the patients' respiratory function.

In our study, scoliosis in tractioned subjects became worse by almost the same degree as that in suspended subjects during one year. This suggests that this gravitational traction is unable to prevent the progression of scoliosis. But spinal elasticity was found to be well maintained by the daily stretching of the spinal muscles as shown in Fig. 2.

The level of apical vertebra among 40 patients with Duchenne muscular dystrophy in our hospital is most frequent around the thoracolumbarsacral transition particularly in the upper lumbar region. With this gravitational traction, the strongest traction works on the lumbar region and the weaker on the thoracic region. Therefore, the distribution of force is compatible with resistance to elongation of a particular region of the spine.

In tractioned subjects, vital capacity percent increased by three percent in average, but, in the control it decreased by five percent during one year. The head down posture forces the chest and diaphragm to aspirate against the weight of the intraabdominal organs. Therefore, during the application of this traction the diaphragm is forced to undergo resistive exercise. In the sitting posture, on the other hand the weight of the intraabdominal organs helps the diaphragm contract.

Tabjan⁴ has given the following three contraindications for this method: 1. hypertension arising from various causes, 2. defects within the spine, 3. scoliosis of neurological origin. Three complications were observed in our study during this traction. With regard to blood pressure an increase in arterial pressure of about 10 to 15 mmHg was observed only at the initial period of traction, but with lapse of time elevation in blood pressure was no longer seen. The other two complications are intolerance and vomiting, and traction had to be suspended due to these causes in two out of five cases.

The results of our previous study indicate

that most of the children with lumbar lordosis would survive into the third decade. Therefore, recently our newly developed thoracic-lumbar-sacral orthosis has been strongly recommended for spinal lordosis. The patients are placed in this brace before and after gravitational traction.

In concluding this paper, emphasis is laid on the fact that the benefits of gravitational traction are an improvement of respiratory function as well as maintenance of spinal flexibility. The number of cases in this study is too small and the period of follow-up is very short. It is therefore considered that this method should be extended to a larger number of patients with Duchenne muscular dystrophy at different stages of progression so that these points can be elucidated.

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