

## Analysis of Atrophy of Gluteus Maximus and Gluteus Medius in Legg-Calve-Perthes Disease

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**Abstract** The cross-sectional area of the gluteus maximus and gluteus medius was measured on both sides in 10 patients with hemilateral Legg-Calve-Perthes disease (LCPD). We used CT scans at the level of the anterior superior spine of the iliac. The area ratio of the affected versus the unaffected side was calculated. The time of measurement from the onset of the disease was 2 months to 3 years and 8 months, and the total number of measurements was 32. We compared the averages between the non-weight bearing period when the patients were using wheelchairs and the period more than 12 months after the start of walking. The recovery from muscle atrophy was very slow and tended to require a very long time.

*Key words:* Legg-Calve-Perthes disease, muscle atrophy, Trendelenburg's sign

### INTRODUCTION

Though most patients with Legg-Calve-Perthes disease (LCPD) show muscle atrophy and Trendelenburg's sign from the early stage of the disease, the relationship with the disease is not clear. We used CT scans to measure the atrophy of the gluteus maximus and the gluteus medius in 10 patients with hemilateral LCPD and evaluated the changes in the atrophy and Trendelenburg's sign during the measurement.

### MATERIALS AND METHODS

From December 1989 to March 1993, we treated 10 patients (7 boys and 3 girls) with hemilateral LCPD at our hospital. We used wheelchairs and abduction braces to reduce weight-bearing and for good containment.

The ages of the patients at the beginning of the treatment ranged from just 5 years to 9 years and 9 months. According to the Catterall radiographic classification, 8 cases were graded as group III, and 2 as group IV.

The CT scans were performed with 10 mm slices at the level of the superior anterior iliac. The margins of the gluteus maximus and gluteus medius on the CT films were traced and scanned with a GT-8000 (Epson, Tokyo Japan) and a Macintosh II ci. We used imaging software (NIH Image ver. 1.44) to measure the cross-sectional area of the gluteus maximus and gluteus medius on both sides, and the ratio of the affected area to the unaffected area was calculated to evaluate the degree of muscle atrophy.

The time from the onset of the disease to the CT measurement ranged from 2 months to 3 years 8 months, and the total number of

measurements was 32. The time from confinement to wheelchairs to the CT measurement was divided into 5 parts to study the recovery of the muscle atrophy. The 4 borders used for dividing were the start of walking, and 5, 9, and 13 months after the start of walking. One-factor factorial analysis of variance (ANOVA) followed by Scheffe's test, Student's paired t-test, and simple regression analysis was used for statistical analysis.

## RESULTS

The ratio of gluteus maximus increased gradually over a long period, from non-weight bearing period to more than 12 months after the start of walking. Although the ratio of the gluteus medius decreased temporarily, it finally increased in the long run (Fig. 1).

As to the mean ratios of gluteus maximus, the mean in 4 cases during the non-weight bearing period in wheelchairs was 83.5% (71

to 92). The means after the start of walking were 85.1% (75 to 91) in 7 cases within 4 months after, 88.0% (79 to 96) in 6 cases from 5 to 8 months after, 86.8% (77 to 98) in 6 cases from 9 to 12 months after, and 90.0% (81 to 97) in 4 cases more than 12 months after.

The mean ratios of the gluteus medius were 84.5% (73 to 90) in wheelchairs, 87.6% (78 to 98) within 4 months after the start of walking, 90.3% (83 to 99) from 5 to 8 months after, 86.2% (76 to 96) from 9 to 12 months after, and 90.0% (84 to 93) more than 12 months after (Table I). In Scheffe's test for comparing the gluteus maximus with the gluteus medius in the 5 groups, there was no significant difference. Between the group in wheelchairs and that more than 12 months after the start of walking, the mean ratio of the gluteus maximus and the gluteus medius increased 6.5% and 5.5%, respectively. Student's paired t-test was performed for comparing the gluteus maximus and medius in the two groups, and the difference was not significant.

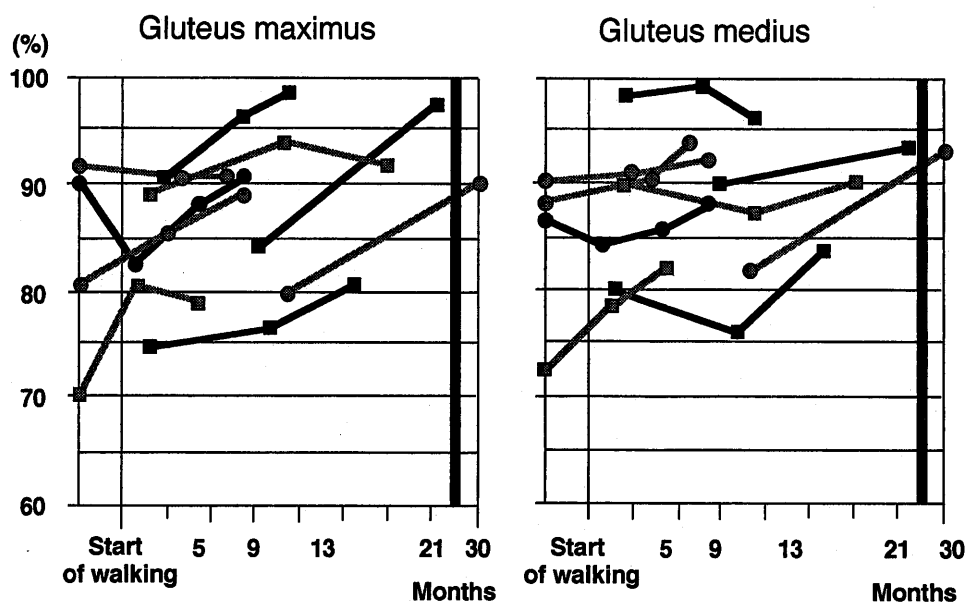


Fig 1 . The ratio of affected/unaffected area  
Explanation :

After measuring the area of the gluteus maximus and medius on both sides on the CT films, the ratio of the affected area to the unaffected area was calculated. The changes of ratios before and after the start of walking are shown in the graph. The total number of measurements was 32.

TABLE 1. The ratio of affected/unaffected area

	non-weight bearing period	After the start of walking			
		≤4M	5-8M	9-12M	13M≤
Gluteus maximus					
Ratio	71~92	75~91	79~96	77~98	81~97
Mean (%)	83.5	85.1	88.0	86.8	90.0
Gluteus medius					
Ratio	73~90	78~98	83~99	76~96	84~93
Mean (%)	84.5	87.6	90.3	86.2	90.0
Number of cases	4	7	6	5	4

## Explanation :

After measuring the area of the gluteus maximus and medius on both sides on the CT films, the ratio of the affected area to the unaffected area was calculated to evaluate the degree of muscle atrophy.

The time from the onset of the disease to the CT measurement was divided into 5 parts to study the recovery of the muscle atrophy. The 4 borders used for dividing were the start of walking, and 5, 9, and 13 months after the start of walking.

Between the group in the non-weight bearing period and that more than 12 months after the start of walking, the mean ratio of the gluteus maximus and the gluteus medius increased 6.5% and 5.5%, respectively.

It seems that recovery from the atrophy requires a very long time in LCPD patients.

Five out of 7 cases within 4 months after the start of walking showed Trendelenburg's sign. Only 1 of the 5 cases showed this sign until 12 months after the start of walking. (0.70;  $p < 0.0001$ ).

## DISCUSSION

The relationship between the ratio of affected to unaffected area and Trendelenburg's sign was examined after the start of walking. In all the measured cases, the ratio of the positive group was 78 to 91% for the gluteus medius, and that of the negative group was 76 to 99%. The ratio of the gluteus maximus in the positive group ranged from 75 to 94, and the ratio in the negative group ranged from 77 to 98% (Fig. 2). There was a positive correlation between the ratios of the gluteus maximus and the gluteus medius ( $r =$

Nakasone et al (1993) reported that atrophy of the gluteus maximus was most severe among the three gluteal muscles in LCPD. In our cases, the mean ratios of the gluteus maximus and the gluteus medius were 86.3% and 87.0%, respectively, and not significantly different.

The ratios in both gluteus maximus and gluteus medius increased gradually over a long period (Fig. 1). We treated LCPD patients by reducing weight-bearing with wheelchairs and abduction braces. ROM

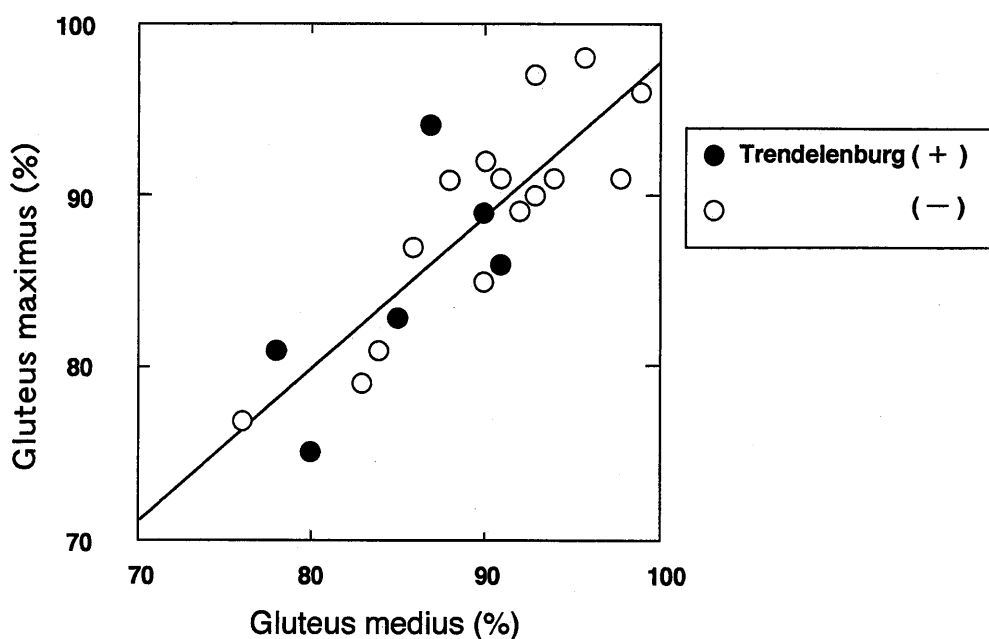


Fig 2 . The ratio of affected/unaffected area and Trendelenburg's sign  
Explanation :

After measuring the area of the gluteus maximus and medius on both sides on the CT films, the ratio of the affected area to the unaffected area was calculated.

Trendelenburg's sign was also checked in the 21 times measurements. There was a positive correlation between the ratios of the gluteus maximus and the gluteus medius. The all ratios with or without Trendelenburg's sign were used to analyse the correlation.

exercises, muscle-strengthening exercises of the hip and knee joints, were also performed to prevent disuse atrophy. However, atrophy of the gluteal muscles was evident from the early stage of the disease, so it seems that recovery from the atrophy requires a very long time.

Five cases showed Trendelenburg's sign, in 4 of whom the sign disappeared within 4 months. This observation is similar to that of a previous report (Valderrama 1963). It is thought that the augmentation of muscle strength in the early stage is due to a change in neural factors which precedes the muscle hypertrophy (Moritani et al 1979). This may be one reason why Trendelenburg's sign disappeared during a rather short period in which recovery from the muscle atrophy was small.

The patients with a ratio of affected to unaffected gluteus medius of more than 91%

did not show Trendelenburg's sign (Fig. 2). LeBlanc et al (1988) reported that in cases with a mean 12% disuse atrophy of the gastrocnemius and soleus, a maximum 26% decrease of muscle strength was measured. Trendelenburg's sign is also called as gluteus medius gait and is said to be caused mainly by functional insufficiency of the gluteus medius. In our cases, no coxa plana and high position of greater trochanter was seen. We surmise that in a short period after the start of walking, strength weakening of the gluteus medius with more than 10% atrophy may cause Trendelenburg's sign.

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