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Effects of Hip Flexion Contracture on Posture and Gait Patterns

Tomoaki Shimada[1], Seiichi Takemasa[1], Yoshihide Kohbu[1], Mami Miyamoto[2], Takahime Sengoku[2], Atsuko Hirayama[2],Tsutomu Okiyama[3], Seiji Kataoka[4], Kyoko Kawata[4], and Hideaki Saegusa[5]

Hip flexion contractures accompanying various orthopedic and neurological conditions not only limit the physical activities of the patients but also distort their posture and gait patterns. The purpose of this study was to elucidate how hip flexion contractures affect the posture and gait patterns of patients with this disability. Seventy-eight patients (mean age of 68.1±10.5 years) with hemiplegia, femoral neck fracture, osteoarthritis of the hip and other conditions causing hip flexion contractures were studied. As a result, not only was an increase of lumar lordosis observed in the supine position, but also a decrease of lumbar lordosis, round back and scoliosis were observed in the sitting and standing positions. With regards to their gait patterns, they walk in various patterns including a bowing gait in the stance phase. These results imply that the clinical pictures of the patient's posture and gait patterns depend on his ability to regulate the position of the trunk and knees as well as the mobility of his spine.

Key Words

Hip flexion contracture,
Postures,
Gait patterns,
Kinesiological study.

INTRODUCTION

Flexion contracture at the hip joint is often found as a complication in a wide variety of physical conditions encountered in a rehabilitation service. This complication is not only a frequent factor limiting the activities of the patients, but also an important factor disturbing their posture and ambulatory functions. For instance, when it appears unilaterally it deters the patient from maintaining normal posture and the patient requires more muscle strength and a higher energy cost than average during ambulation. When it exists bilaterally, it might confine the patient to a wheel chair existence or even a bed for the rest of his life.

The study reported here was designed to elucidate the effects of hip flexion contracture on posture and gait patterns from a kinesiological point of view.

Materials and Methods

Thirty six male and fourty two female patients between ages of 16 and 84 years (average age 68.1 ± 10.5 years) with flexion contractures at the hip joints were

School of Allied Medical Sciences, Kobe University[1], Kobe, Takebe Orthopedic Clinic and Rehabilitation Hospital[2], Amagasak, Kobe Rehabilitation Hospital[3] Kobe, Ono Municipal Hospital[4], Ono and Hokuto Hospital[5],Kobe, Japan.

evaluated to characterize a relationship between the hip flexion contracture and posture or gait patterns. Of the 78 patients, 14 patients with femoral neck fractures and 7 cases of parkinsonism and 7 cases of osteoarthritis of the hip were included, as well as 22 hemiplegics. The durations from the onset of their disabilities to the time of this study were as follows: 16 patients were within 1 year, 34 were within 3 years, 11 were 5 years and 17 were over 5 years.

The Thomas maneuver was used to determine the presence and degree of hip flexion contracture. This method consisted of placing the patients in the supine position and then flexing the unaffected leg until the lumbar lordosis was eliminated. The flexion present in the affecetd leg was then measured by subtracting its maximum degree of extension from 180 degrees.

In order to analyze the structure of hip flexion contractures affecting posture and gait patterns from a kinesiological point of view, appearance patterns of the hip flexion contracture, complication of the knee flexion contracture, measurements of leg difference and tightness of the rectus femoris and iliotibial band were evaluated as well.

In addition, the postures of the patients in supine, sitting and standing positions, as well as their patterns of gait, were evaluated to determine whether they were affected by hip flexion contracture.

RESULTS

1. The Severity of Hip Flexion Contracture

The severity of flexion contracture of the hip is illustrated in figure 1. Sixty nine hips had flexion contractures on the right side and 65 hips on the left side. Thirty

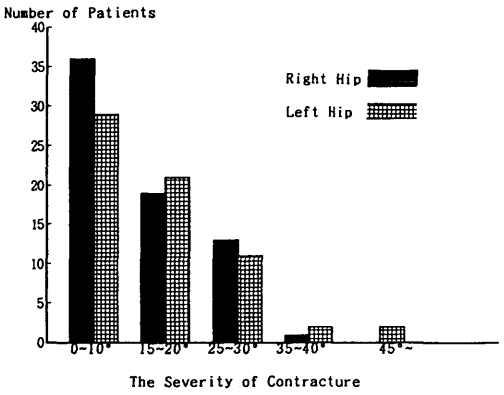

Figure 1. The severity of hip flexion contractures in 78 patients

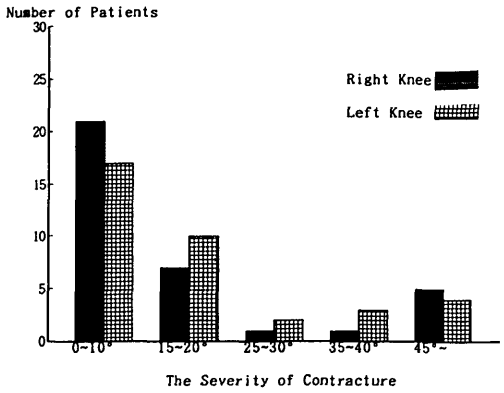

Figure 2. The severity of knee flexion contractures accompanying hip flexion contractures in 78 patients

three hips had a contracture greater than 15 degrees on the right side, and 36 on the left side. Of these, 14 of the right and 15 of the left side were greater than 25 degrees (Figure 1).

2. Appearance Patterns of Hip Flexion Contracture

Of the 78 patients, the hip flexion contractures was concealed in 51 patients by compensation through pelvic tilt and lumbar lordosis. However, the flexion contractures was not concealed in 27 patients despite such compensation. Of

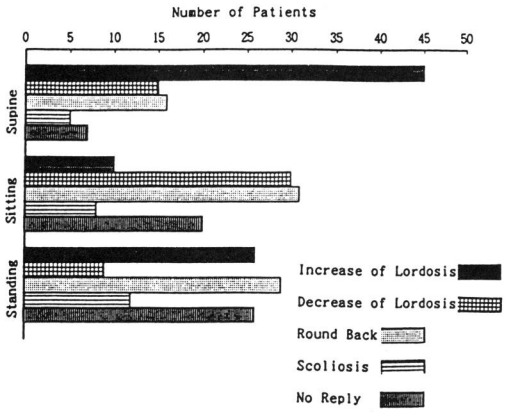

Figure 3. Abnormal postures seen in the patients with hip flexion contractures

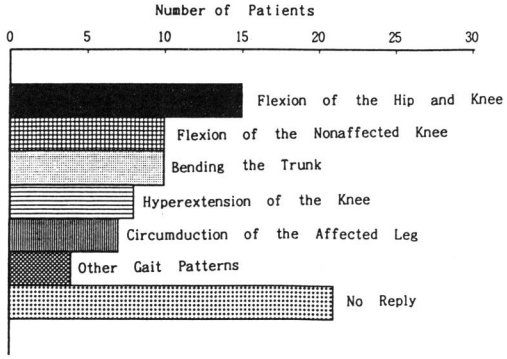

Figure 4. Variations of gait patterns seen in the patients with hip flexion contractures

these 78 patients, 22 had unilateral and 56 had bilateral hip flexion contracture.

3. Presence of Flexion Contractures of the Knee

Flexion contractures of the knee were also obseved in 40 patients and the severity is shown in figure 2. Of these, 35 had right and 36 had left knee contracture. In terms of severity, 14 right and 15 left knees had greater than 15 degrees of flexion contracture (Figure 2).

4. Leg Length Measurements

In 14 patients a leg length discrepancy of more than 2 cm was observed, with 20 patients having less than 2cm discrepancy.

5. Tightness of the Rectus Femoris and Iliotibial Band

It was found through the hip-up test that 50 patients had tightness of the rectus femoris and Ober's test showed that 45 had tightness of the iliotibial band.

6. Abnormal Postures Observed in Patients with Hip Flexion Contractures

As shown in figure 3, in the supine position, an increase of lumbar lordosis was observed in 45 patients. In contrast, a decrease of lumbar lordosis and round back were observed in 15 and 16 patients respectively. In the sitting position, it was found that lumbar lordodis decreased in 30 patients, round back in 29 patients, and scoliosis in 8 patients. In the standing position, 26 patients had an increase of lumbar curvature and 29 had roud back deformity (Figure 3).

7. Gait Patterns Seen in the Patients with Hip Flexion Contractures

Of the 78 patients, 38 were able to ambulate independently and 29 could walk with the aid of orthoses such as walkers and canes. Of the 57 patients who were able to ambulate, 15 patients displayed a gait with both knee and hip flexed on the involved side. A bowing gait and a gait with flexion of the involved knee were obseved in 10 patients each (Figure 4.).

Discussion

In many patients with the orthopedic and neurologic conditions hip flexion contracture, which is often caused by spasticity and tightness of hip flexors, is an important cause of abnormal posture and disturbs normal gaits patterns as well (1−3).

In this paper we discuss the characteristics of posture and gait patterns seen in patients with hip flexion contracture.

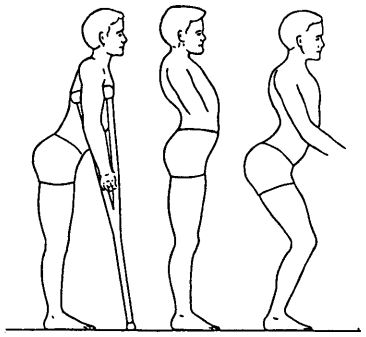

Figure 5. Postural substitution for standing and walking in the patients with hip flexion contractures. (left) crutch support of the forward trunk, (center) lordosis to place trunk weight behind the hip joint axis, (right) combined knee flexion and lordosis. (Perry J; Contracture. A Historical Perspective. Clin Orthop Relat Res 219; 10, 1987)

1. Characteristics of Postures Observed in Patients with Hip Flexion Contracture

Spasticity or tightness in the hip flexors causes downward rotation of the pelvis, and this position in turn causes exaggeration of the normal lumbar curvature. In other words, loss of extension at the hip is compensated for by an increase in lordosis of the lumbar spine, and a slightly diminished extension may be easily concealed by an unnoticed change in posture.

According to Roosth and his colleague, the clinical picture of the hip flexion contracture in patient's standing posture depends on his ability to regulate the position of his trunk and knees(3). For example, when the patient stands with knees straight and trunk erect, there is excessive lumbar lordosis. When the knees are kept straight but the trunk is not held erect, a trunk-flexion position is assumed. When the knees are slightly flexed, the trunk flexion or lordosis, whichever is present, is less pronounced. Day also suggested that the mobility of the lumbar spine affects trunk position and the degree of lumbar lordosis(4). Instead of increased lordosis of the lumbar spine, there is also a tendency for the patient to stand or walk in a stooped position as he flexes his dorsal spine to compensate for its deformity(5). In our study, 29 patients had a stooped position (round back) in both sitting and standing.

The posture of each patient with hip flexion contracture also varies with the strength of his muscles around the hip and trunk, the patterns of his spasticity and his trainability(3). Phillips states that contracture of any or all of the muscles that flex the hip restricts the effective strength of the hip extensors groups and causes marked functional limitation(5). Of particular importance is the exaggeration of any weakness that might exist in the gluteus maximus. The gluteus maximus plays an important role in rotating the pelvis backward so that the lumbar lordosis decreases. But once hip flexion contracture occurs, action of this muscle is reciprocally inhibited by a strong pulling action of the hip flexors.

Most patients with mild to moderate flexion contracture either extend the trunk and have excessive lumbar lordosis, or they flex the knees and reduce the forward pelvic tilt produced by the hip flexion contracture. Often, a combination of slight leaning forward and slight knee flexion is the result.

If flexion contracture is more severe, active extension of the trunk to compensate for the pelvic tilt appears to be too difficult. Eventually the patient accommodates for the hip flexion deformity and assumes a more erect posture by flexing his knees, thereby masking the hip flexion contracture to some extent. Knee flexion under these circumstances allows the patient to reduce the leverage exerted by

gravity on his trunk, by eliminating the forward leaning posture(3) (Figure 5).

Knee flexion and heel cord tightness may follow a persistent hip flexion contracture. These occur because the patient tends to walk with the knees flexed and the ankles plantar flexed. This secondary knee flexion deformity may or may not be a fixed deformity in some patients. Especially in a young children with spastic cerebral palsy, however, full or almost full active or passive knee extension may be demonstrated during examination. And when he is walking, he may be able to extend his knee voluntarily during the appropriate phases of gait. Under these circumstances, a surgical transfer of the insertions of the hamstrings to the femur to correct knee flexion deformity, as suggested by Eggers(6), or even an over-stretching of this muscle, might result in a deformity of genu recurvatum while the hip flexion contracture remains unchanged.

On the other hand, if the knee flexion contracture is either a true contracture secondary to a long-standing postural deformity, or is a result of primary hamstrings tightness, or a consequence of both of these factors, both active and passive extension of the knees are limited. In this situation, if a surgical release of the hamstrings is performed without correcting hip felxion contracture, active knee flexion may become possible, but the patient's standing posture is now unstable.

In most cases, as hip extension does not increase, the patient may gain ability to extend his knee, but exaggerates his lumbar lordosis with resulting prominence of the buttocks(3).

Abraham also reported that the role of flexion contracture of the hip as a contributory factor in flexion deformity of the knee, and vice versa(7). These reports imply a mutual association between the flexion contractures of the hip and knee.

2. Gait Patterns of the Patients with Hip Flexion Contracture

Contractures of the ankle, knee, or hip decrease the patient's ability to walk. Gait velocity is slowed and high energy costs are imposed by the postural substitution required of adjacent segments. As described above, the significance of hip flexion contracture depends on associated spine mobility(2, 4). Patients with flexible backs accommodate by lordosis in the lumbar spine. Others stand with knees flexed. When these substitutions are not possible, support of the trunk depends on the use of crutches or other aids(2).

Especially in unilateral hip flexion contracture, not only is the hip flexed, but also the knee. The foot is usually plantar flexed so that the patient walks on his toes on the involved limb. An apparent leg length discrepancy may result from the distortion of the pelvis because of the flexed hip. If unilateral iliotibial band tightness exists, it produces additional problems and can be more complicated than bilateral tighness, that is, the leg on the affected side appears to be longer because of the pelvic obliquity. With the pelvis low on the side of the tightened band, the pelvis will obviously be high on the opposite side, thus causing the femur on the high side to become adducted. In this case, a leg length discrepancy is apparent, with the leg on which the tight band exists appearing to be longer. When this leg length discrepancy occurs, the patients walk in flexing their affected hips and knees simultaneously to propel the limbs smoothly against the ground. Therefore, as Phillips(5)emphasizes, leg length measurements should always be included with range of motion and muscle strength tests.

When hip flexion contracture occurs unilaterally to a degree that can not be concealed by compensation with increased pelvic tilt and lumbar lordosis, the patient often walks bending his trunk during the stance phase of the affected limb. Ducroquet calls this a bowing gait(8). Ten patients showed this gait pattern in our study as well. If this sort of hip flexion contracture exists bilaterally, the patient walk with a crouching posture through one gait cycle(8). Generally speaking, isolated contracture of the iliopsoas muscle rarely occurs. Almost all hip flexion contractures include the rectus femoris, sartorius, tensor fasciae latae (iliotibial band), and in fact, all of the soft tissues of the anterior compartment of the hip. Of these, the tensor fasciae latae, rectus femoris and sartorius muscles are the biarticular muscles which are particularly responsible for the hip flexion contracture.

Tightness of these muscles changes the gait pattren. Because of the restriction of knee motion resulting from tightness of the rectus femoris, for example, that phase of gait in which the hip is extended and the knee flexed could not be executed in physiological manner. To propel the lower extremity on the affectted side, the patient has to abduct and rotate the hip outward during slow walking. This is called the circumduction gait. In the fast walking and running, he has to lift the pelvis on the side of the lesion. It is known that the lower limb can be considered from the biomechanical point of view as a kind of pendulum(9). The swing of this pendulum requires less energy cost if the knee can be flexed sufficiently. In this case the person's center of gravity progresses on a combined flat sinusoid curve during the gait.

However, in the condition we are considering, because of the shortening of the rectus femoris muscle, a sufficient knee flexion is not possible. Therefore the swing phase needs more energy and the shape of the sinusoidal curve is also changed, causing a constant additional energy expenditure to the subjects.

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