Advances in Orthopedics and Sports Medicine

Kosmos Publishers

Sort Communication **Adv Ortho and Sprts Med: AOASM-106**

Introduction of D Test; Daikuya's Quasi Closed Kinetic Chain Test-A New Evaluation Method Examining the Lower Limb Kinetic Chain

Shinichi Daikuya[1*], Yumi Okayama

[1]Department of Rehabilitation, M3 Doctor Support Inc., Tokyo, Japan
[2]Osaka University of Human Sciences, Faculty of Human Science, Department of Physical Therapy, Osaka, Japan

[*]**Corresponding author:** Shinichi Daikuya, Department of Rehabilitation, M3 Doctor Support Inc., Tokyo, Japan. Email: s-daikuya@m3ds.co.jp

Citation: Daikuya S, Okayama Y (2018) Introduction of D Test; Daikuya's Quasi Closed Kinetic Chain Test-A New Evaluation Method Examining the Lower Limb Kinetic Chain. Adv Ortho and Sprts Med: AOASM-106.

Received Date: 19 September, 2018; **Accepted Date:** 25 September, 2018; **Published Date:** 03 October, 2018

Abstract

It is necessary to find functional impairment at an early stage in rehabilitation process in order to smooth return to sports and social reversion.

For avoidance the delay of acquisition of sports activity and ADL, an impairment at the weight bearing situation must be found in early stage of rehabilitation; i.e. non-weight bearing phase. So, we developed an evaluation method to prevent mal-alignment, which induces the disorder such as pain around the joint of the lower limb in advance when starting the practice of the sports movement at the weight bearing situation, called D test; Daikuya's quasi closed kinetic chain test.

D test is an evaluation maneuver on supine position for investigation the problem of kinetic chain related to mal-alignment during movement at the weight bearing situation.

A procedure of D test is consisted of three phases. On the first phase, therapist searches a joint motion axis of ankle dorsal flexion of a subject. And next, normal axis of ankle dorsal flexion was compared to actual axis. Finally, a therapist thinks about factors and effects due to ankle axis abnormality and observes and analyzes the kinetic chain from foot to head.

By improving the abnormality of motion axis and kinetic chain in lower limb at D test on supine position based on the obtained evaluation findings, abnormality of motion axis and kinetic chain is also improved even at the weight bearing situation. And D test is useful not only to find problems in early phase of rehabilitation process but also to exercise instruction to contribute to the prevention of injury in healthy people and athletes.

Although D test is a qualitative and subjective method, it is extensively useful in the field of sports rehabilitation and physical therapy evaluation by examiners' skill. And it is necessary to master the human functional anatomy and kinesiology for clinical useful application of D test.

1. Keywords: Closed kinetic chain; Physical examination; Physical therapy; Prevention; Sports medicine

2. Introduction

Although there are several principles in medical rehabilitation process, typical one of them is the rehabilitation proceeds without delay to the clinical path (rehabilitation program). Clinical path (rehabilitation program) is the statement of type and timing of permitted movement. The rehabilitation along with clinical path (rehabilitation program) is harder than expected and is also misunderstood by many therapists. In the clinical path (rehabilitation program) mentioned the type and timing of permitted movement, therapist must recognize that "the movement that is permitted can be carried out independently at that time", not "to start practicing at the time".

In the case of starting a practice of target movement or a therapist is searching for problems by looking at target movement on the authorized date, it is thought that the probability that the timing of permitted movement will be later than the provision will increase. Therefore, in rehabilitation process and physical therapy evaluation, it is too late to observe the movement at the timing of permitted movement, and it is often necessary to predict the problem in advance. So, from the viewpoint of clinical observation and as a new method of a prediction mean of the problem, we developed the D test; Daikuya's quasi closed kinetic chain test. In this paper, we introduce the procedure and the representative findings of D test.

3. D test; Daikuya's quasi closed kinetic chain test

D test is observation of kinetic chain and assessment of factor of the aspects of the kinetic chain, which is induced from passive, quick and repetitive dorsiflexion of ankle joint, on supine position. In D test, it is necessary to compare the aspects of kinetic chain on subject-specific ankle motion with on normal ankle motion while inspecting the stable dorsiflexion axis. In the kinetic chain from the ankle and foot, the dorsiflexion on the stable, which is almost subject-specific motion axis, propagates through the lower leg, the knee to the femur, the pelvis, the abdomen, the thorax and the shoulder band and eventually affects the head and the neck. In D test, observation the state of such kinetic chain is performed in the supine position. Therefore, D test does not judge as positive / negative, but reproduces the state of the kinetic chain at the load position in the non-load position.

3.1. Procedure of D test: Case 1

First, using the MP joint as the load stimulus point, we perform a dorsiflexion passively **(Figure 1-a)**. (**Figure 1)** shows the state of motion on the dorsiflexion by subject-specific motion axis, which is the condition of the position of abduction with easier motion and larger range. In the usual case, the range of dorsiflexion is the largest in the subject-specific motion axis.

Next, we perform similar motion in the motion axis considered normal **(Figure 1-b)**. In **(Figure 1-b)**, the range of dorsiflexion is smaller than that in **(Figure 1-a)**. Repeat the movements shown in **(Figure 1-a** and **Figure 1-b)** and observe the kinetic chain seen during the dorsiflexion motion in the subject-specific motion axis. Simultaneously, factors related to limitation of dorsiflexion in the normal motion axis are identified by the end feel of joint motion.

When the finding as shown in **(Figure 1-a)** is obtained, the following hypothesis about the characteristics of movement at the load position is established. In the occasion of the stepping motion by the right lower limb with loading, the foot direction probably shows the angle shown in **(Figure 1-a)**, and the knee joint moves inward with respect to the foot (knee valgus and external rotation). In **(Figure 1-a)**, there is no lateral bending or rotation in the trunk, so that it is thought that there is no mal-alignment of the trunk when stepping with weight bearing. In such a case, by normalizing the kinetic chain from the ankle before the load is permitted, the mal-alignment of the lower limb can be prevented in advance.

As an example of the load operation, when actually trying the front lunge, the similar findings about the directions of knee and foot shown in **(Figure 1-a)** was observed; i.e., the knee joint is moving inward with respect to the foot on frontal plane (knee flexion at foot abduction position, (**Figure 2**). In addition, movement such as lateral

bending and rotation has not occurred in the trunk. Then, after the intervention for improvement of the motion axis of dorsiflexion, and D test is executed again, it becomes as shown in **(Figure 3)**. In **(Figure 3)**, dorsiflexion with less inclination of the foot compared with (**Figure 1-a)** becomes possible, and the range of motion is also expanding. In addition, inward movement of the knee joint against the foot as seen in **Figure 1-a** was absent, the similar motion is observed at the time when the finding like **Figure 3**, and the mal-alignment seen in **Figure 2** disappears **(Figure 4).**

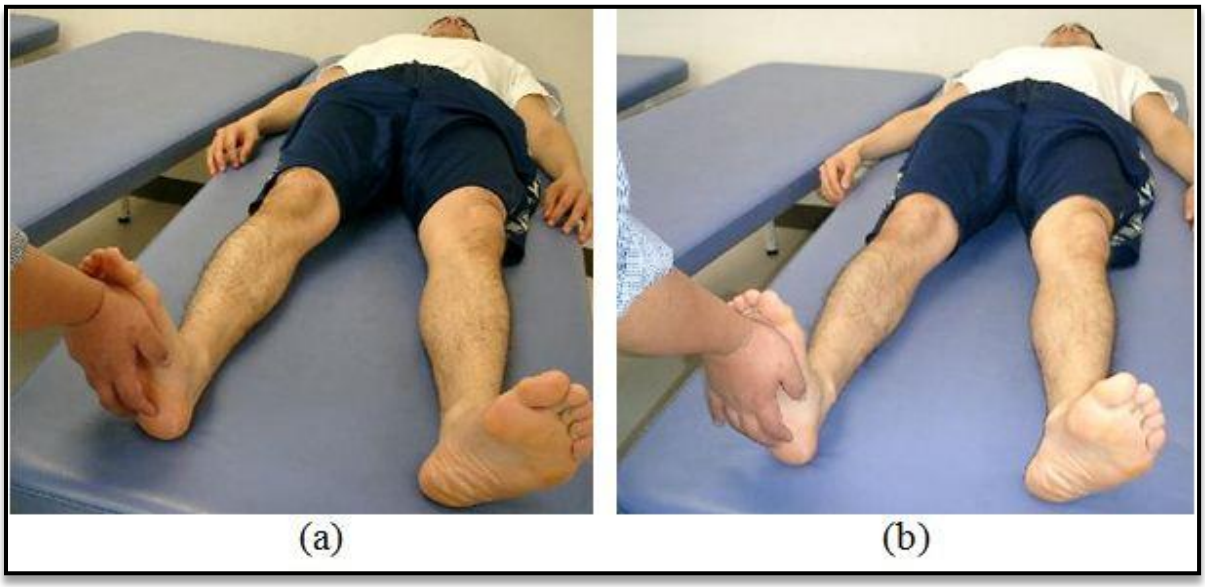

Figure 1a, b: Conditioning operation and observation in Case 1. Quick passive ankle dorsiflexion was performed with ankle slightly abducted in left figure (a), which resistance feel was smaller than other position, and kinetic chain from the lower leg to the upper body was observed. In right figure (b), quick passive ankle dorsiflexion at foot neutral position (without abduction). The range of dorsiflexion of left figure was larger than that of right figure. So, kinetic chain at weight bearing position was thought to be with foot abduction.

Figure 2: Observation of kinetic chain on weight bearing situation. When natural stepping, knee flexion with foot abduction (knee valgus and external rotation) was observed.

Figure 3: Conditioning operation and observation after increase of range of ankle dorsiflexion without foot adduction in Case 1.

Figure 4: Observation of kinetic chain on weight bearing situation after improvement of mal-alignment in Case 1. When natural stepping, knee valgus and external rotation disappeared.

3.2. Confirmation of kinetic chain in D test: Case 2

The same as the case 1, the MP joint is used as a load stimulus point, and a dorsiflexion is carried out passively **(Figure 5)**. Next, similar motion in normal motion axis was performed **(Figure 6)**. Repeat the motions shown in **Figure 5** and **Figure 6** to observe the kinetic chain and predict the assumed propagation route of the load during D test (dorsiflexion movement) **(Figure 7)**. For example, when a series of observations shown in (**Figure 5) to Figure 7** are obtained, the following hypothesis about kinetic chain in closed kinetic chain is established. When the subject

steps on the left lower limb on weight bearing situation, the foot direction shows the angle shown in **Figure 5**, and the knee joint moves inward with respect to the foot (knee valgus and external rotation). And, it can be predicted that the load propagation route takes on the form of the arrow in Figure 8. In addition, when the load is increased by stepping the left lower limb forward from the prediction of the load propagation route **(Figure 8)**, the appearance of the left side bending of the trunk is predicted. As a representative factor of these series of kinetic chains is thought to be as follows; increase of leg external rotation and inward displacement of knee at dorsiflexion often caused by abnormality of dorsiflexion axis of ankle, and the tonus of abdominal muscle group is low in trunk. It is thought that the load may not propagate properly due to such displacement of the limb joint and decrease of the muscle tension. And, actually stepping, a situation that approximates the prediction can be observed **(Figure 9)**.

On the other hand, as shown in **(Figure 10)**, although a slight inward displacement of knee was seen on the contralateral side (right leg), displacement of the load propagation route as seen on the left side is not recognized. Therefore, in the action of stepping the right lower limb forward, a slight inward displacement appears in the knee joint, but it can be predicted that side bending of the trunk is not recognized. **(Figure 11)** shows the aspect when the right leg is stepping forward, and matched findings with D test was observed in closed kinetic chain.
As described above, from the reproduction of closed kinetic chain on supine position like D test, it is possible to obtain useful findings for confirming the interlocking motion of the plural joints.

Figure 5: Conditioning operation and observation in Case 2 (Left side).

Figure 6: Conditioning operation and observation at normal axis of dorsiflexion in Case 2 (Left side).

Load stimulus
(Quick dorsiflexion)
With foot abduction

Load stimulus
(Quick dorsiflexion)
Without foot abduction

Figure 7: Observation of load stimulus and kinetic chain using dorsiflexion movement in Case 2 (Left side)

Figure 8: Prediction of load propagation path in Case 2 (Left side). The load stimulus from the foot is dispersed by the inward displacement of the knee, and when it reaches the pelvis, the right rotation of the pelvis It can be predicted that it will propagate to the contralateral side by lifting. That is, it can be predicted that a load is applied to the line from the left lower limb to the right shoulder in the stepping-out motion.

Figure 9: Observation of kinetic chain on weight bearing situation after improvement of mal-alignment in Case 2 (Left side).

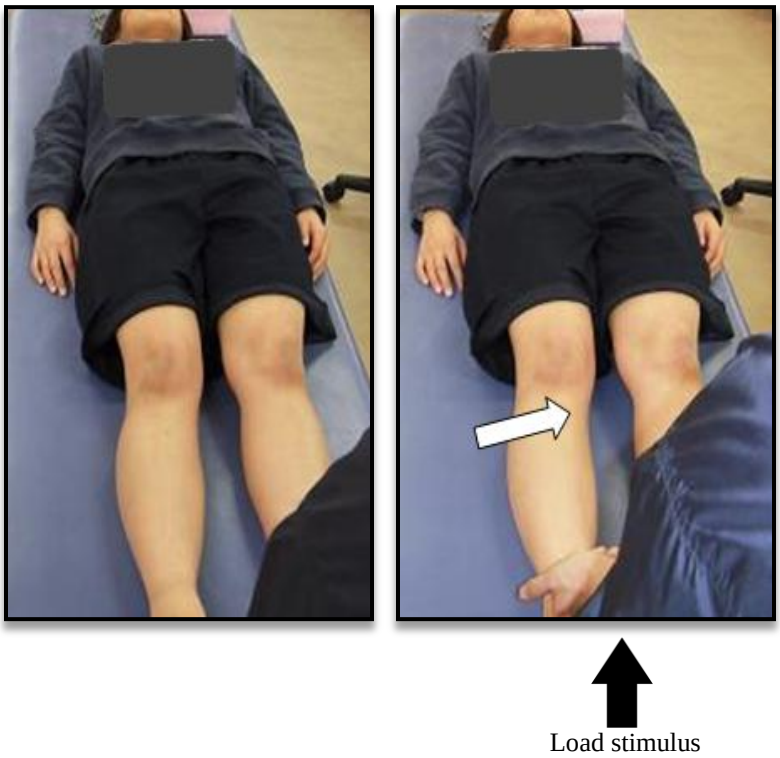

Figure 10: Observation of load stimulus and kinetic chain using dorsiflexion movement in Case 2 (Right side).

Figure 11: Observation of kinetic chain on weight bearing situation after improvement of mal-alignment in Case 2 (Right side).

4. Conclusion

As a method of forecasting problems about kinetic chain on weight bearing situation, D test, which is our original methods, was introduced based on actual application examples.

In D test, the motion axis of dorsiflexion is carefully searched and the kinetic chain is evaluated / hypothesized from foot to head. In actual clinical situation, it is useful to predict problems of invisible movement using D test, and in example, searching the problem in weight bearing situation at the non-weight bearing phase.

The purpose of this paper is not to disseminate this test. Through this article, we would appreciate reaffirming the importance of the basic knowledge on the appropriate joint movement axis and kinetic chain.

5. Acknowledgments

Thanks to those who cooperated with the shooting and subjects, and those who provided the place.