行政院國家科學委員會補助專題研究計畫期中報告

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※　　膝關節病人臨床治療成效之生物力學評估　　　　※
※　Biomechanical Evaluation for The Effect of Clinical Treatment in Patients With　※
※　Osteoarthritis of The Knee　※
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計畫編號：NSC　89－2314－B－039－052－M08
執行期間：　89 年　08 月　01 日至　92 年　07 月　31 日

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□ 赴國外出差或研習心得報告一份
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□ 出席國際學術會議心得報告及發表之論文各一份
□ 國際合作研究計畫國外研究報告書一份

執行單位：中國醫藥學院 物理治療學系

中　華　民　國　90　年　05　月　24　日

行政院國家科學委員會專題研究計畫成果報告
膝關節病人臨床治療成效之生物力學評估
Biomechanical Evaluation for The Effect of Clinical Treatment in Osteoarthritis of The Knee

計畫編號：NSC 89－2314－B－039－052－M08
執行期限：89 年 8 月 1 日至 92 年 7 月 31 日
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一、中文摘要

臨床文獻指出 60 歲以上的老年人，超過 31%皆患有骨性膝關節炎之症狀。隨著人口年齡的老化，這將是一個相當重要的問題。臨床上，膝關節炎病人主要的抱怨包括：疼痛、關節僵硬、站立穩定度不好、肌肉無力、膝關節功能退化等。而這些徵狀造成膝關節炎病人在日常生活的活動上感到困難，例如由坐到站立、上下樓梯及步行等。臨床上，目前治療膝關節炎的主要方法包括注射關節潤滑劑、關節鏡治療、藥物治療及物理治療等。目前，造成膝關節炎的最主要因子仍不清楚，但由膝關節炎病人的 X 光片顯現出膝關節有異常的磨損及變形，其表示膝關節在各種日常活動中承受了不適當的負荷。而缺乏膝關節炎演化的長期追蹤資料及治療成效的量化資料，亦造成治療方法之選擇與醫療資源花費上的問題。而要了解膝關節負荷及量化膝關節炎治療成效，則必須透過生物力學的分析，來探討膝關節在治療前後功能的改善情形。然而有關於膝關節炎治療成效評估的文獻中，並未有探討肌肉骨骼系統在日常生產之活動中的動態負荷問題。雖有部份學者探討治療前後膝關節屈肌群及伸肌群的力矩的變化，但此靜態的量測，並不能完全表示膝關節的功能及肌肉骨骼的動態負荷情形。因此，本研究的主要目的為(1)探討膝關節在各種日常活動中動態的負荷，其包括在不同椅高下由坐到站立及步行時，病人膝關節所承受的三維力量、力矩與關節功率，以及站立的穩定性。(2)藉由生物力學的分析，來量化膝關節炎病人接受不同治療方式(注射關節潤滑劑、關節鏡治療、藥物治療、物理治療)長期成效評估。(3)探討骨科及物理治療之膝關節炎評估指數與日常活動之膝關節功能的關係。

關鍵詞：膝關節炎、生物力學、由坐到站

ABSTRACT

The purposes of this study are (1) to investigate the dynamic loadings (the three-dimensional joint force, moment and power of the knee joint) during the activities of daily living, including sitting to standing, level walking and the stance stability; (2) to quantitatively evaluate the effect of these four clinical treatments (intra-articular lubricants, drug therapies, arthroscopic debirdement, and physical therapy) for the OA knee with biomechanical analysis; (3) to investigate the relationship between the clinical evaluation index of OA knee and the functional performance of activities of daily living. The expected results of this study are the findings of the mechanical loadings (joint moment, force and power) of musculoskeletal system in lower extremity and the dynamic loading of muscle groups. Based on the biomechanical analysis for the

OA knee, it will be able to provide the basic guidelines for the patients with OA knee to prevent the activities or posture which is vulnerable to secondary knee injury. This study will be of practical benefit to the design of orthoses of lower extremity. It will be also helpful for the evaluation of different clinical management and the prediction of medical cost.

Keywords: Knee Osteoarthritis, Chair Rising, Biomechanics.

BACKGROUND AND OBJECTIVE

Osteoarthritis (OA) is a widespread, slowly developing disease, with a high prevalence increasing with age (Badley et al, 1992). It is also one of the most common causes of functional limitations and dependency. The most common large joint involved in the disease is the knee joint. Osteoarthritis of the knee is particularly disabling due to the symptoms such as pain, stiffness, decreased range of motion, and muscle weakness. These symptoms can severely impair or limit the ability to climb a flight of stairs, rise from a chair, and walk, ultimately leading to a loss of independence (Cooke et al, 1986). There is no specific known underlying reason for the development of osteoarthritis and the resulting deformity. However, the abnormal joint loadings on an OA knee result in pain on the joint and lose of joint function. The biomechanical analysis of the loading and the function of knee joint is greatly important to evaluate the advanced knee arthritis and understand the pathology of the OA knee.

Clinically, the main treatments of the OA knee are intra-articular lubricants, drug therapies, arthroscopic debirdement, and physical therapy program. By understanding of the biomechanics during activities of daily living, it is helpful to quantitatively evaluate the effect of these treatments. The aim of this study is to evaluate the effect of clinical treatment to osteoarthris of the knee. Biomechanics of the chair rising, stance balance, level walking and isometric muscle strength of hamstrings and quadriceps will be analyzed to quantitate the effect of clinical treatment and to classify the OA knee by comparing the finding from radiography.

RESULTS AND DISCUSSION

The subjects source of this study are from the patients who accept clinical treatment (intra-articular lubricants, arthroscopic debirdement, nonsteroidal anti-inflammatory drug therapies, or physical therapy program) of OA knee. To guarantee sufficiently varying input data for modelling, the subjects were selected on the following criteria: 1. No OA occurred at other joints except the knee. 2. The severity of OA knee is grade I or II.3. No present injuries to lower extremity. For comparison, the data of the healthy normal subjects with compatible age was collected as the control group. Data collection for chair rising, level walking, stance balance, and muscle strength was performed for each subject every two weeks. For each subject, the duration of data collection was lasted for 6 months at least.

The data collection of control group has been finished in this year. Also, we are collecting the data of four different groups of patients and it will be finished and discussed in the next two year. The results of control group are listed and discussed in the following section.

The subjects were walking on the level ground and raised from the chair with different chair's height (85%, 100% 115% knee's height). Motion analysis system with two force plateforms were used to collected the data of ground reaction forces/moments and segmental movements. A personal designed programs written in MATALB language was used to estimated joint movements and joint forces/moments. Euler angle was used to calculate the three-dimensional joint movements of lower limbs for each test. The range of motion for hip flexion/extension, hip axial rotation, hip abduction/adduction, knee flexion/extension and ankle dorsiflexion/plantarflexion were showed in the Figure 1. The results showed that the range of motion for knee flexion/extension, hip flexion/extension, and ankle dorsiflexion/plantarflexion were decreased with the height of the chair during the test of chair rising.

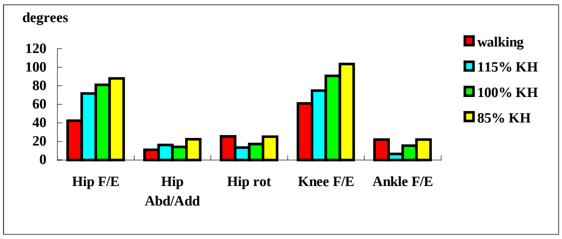

Figure 1: The joint range of motion of lower limbs in level walking and chair rising.

The joint moments of hip extension, knee extension and ankle dorsiflexion during chair rising was showed in the Figure 2. The center of pressure of foot was moving from toe to the ankle joint during the chair rising. Hence, The dorsiflexion moment was found in the ankle joint. The results also showed that the joint moments of knee extension and ankle dorsiflexion were decrease with the height of the chair. It is consist with the results that the patients have problem to raise form the chair if the height of chair is less than 100% of knee height.

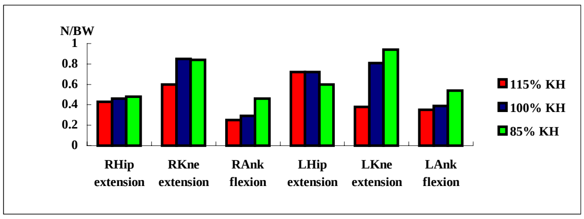

Figure 2: The joint moments during chair rising. N: Newton; BW: body weight.

For the control group, the results also showed that the knee extension moment of dominate limb was greater than that of non-dominate limb during the chair rising. However, if the height of chair is less than 100% knee height, there is no difference between two lower limbs. For the patients with Osteoarthritis knee, the results of affected side are greater than that of un-affected side. It is because that the patient shifted his/her weight to un-affected side in order to reduce pain. The details will be discussed after the data collection of patients is finished.

Standing balance were measured with a AMTI fore plates. The tests consist of two sensory conditions: (1)comfortable stance, eyes open; (2)comfortable stance, eyes closed. The testing sequence will be random. Each trial at least lasted for 20 seconds. The parameters to describe the stance stability, including sway path, sway velocity, sway acceleration, dispersion index and stabilometry area were computed in this study. The path of center of pressure in horizontal plan is showed in Figure 3. For the control group, all the parameters (the length of sway path, velocity, acceleration, dispersion index and stabilometry area) showed that there were differences between two tests (eyes closed and eye open). It is implied that the stability of balance is decreased when the eye is closed.

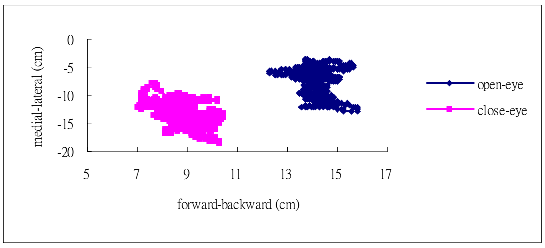

Figure 3: The path of center of pressure

SELF-EVALUATION

A personal designed programs written in MATALB language for estimating joint movements and joint forces/moments have been developed for the tests of level walking, and chair rising. Also, the programs for estimating the parameters of stability of balance were finished too. We also have finished the data collection of control group. The results were listed and discussed above.

The ongoing tasks of next two years (2nd and 3rd years) are data collection of four different groups of patients.

In order to compare the results with previous studies, we planed to collect the data of chair rising with four different chair's height (65%, 85%, 100%, and 115% knee's height) in our original project. However, we found that patients and some control group subjects have problem to perform the movement of chair rising with the chair's height at 65% knee's height. The test of this chair's height will be the patients' option in the next two years.

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