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The Effects of External Supports on Knee Flexion Degree

BAYRAM UNVER, PhD, PT, Asc[1)], VASFI KARATOSUN, MD, Asc[2)], EMINE KILIC, PT, MSc[1)]

[1)]*School of Physiotherapy, Dokuz Eylül University, Izmir, Turkey: Korutürk Mahallesi, Meşe Sokak Çam Apt. No: 7/3 BALÇOVA, IZMIR, TR-35330, Turkey.*
TEL +90 232 2783118, FAX +90 232 2778180, E-mail: bayram.unver@deu.edu.tr
[2)]*Orthopedics, Dokuz Eylül University, Izmir, Turkey*

Abstract. [Purpose] The aim of the study was to investigate the effects of external supports on the degree of knee flexion. [Subjects] Twenty volunteers (40 knees) were recruited to the study. [Methods] Active knee flexion was measured using a goniometer with the patient in the supine position. After measuring the knee flexion with the leg naked, the same procedure was repeated after application of an elastic stocking, an elastic bandage or a Jones bandage. [Results] The Jones bandage appeared to inhibit the knee flexion angle by 16.8%. This value was 2.7% for the elastic stockings and 4.2% for the elastic bandage. [Conclusion] These results may be used in the modification of the rehabilitation regime after total knee replacement.
Key words: Total knee replacement, Compressive dressing, Flexion

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INTRODUCTION

There are two main goals after major knee surgery[1–3)]: The first is rapid mobilization of the operated joint that is essential for reducing the duration and costs of rehabilitation[4)]. The second goal is the effective prevention of edema and hematoma[1)]. It is generally accepted that the control of swelling can improve wound healing, reduce pain, and permit rapid rehabilitation of the knee after trauma or surgery[5)]. While the accelerated flexion regime is utilised for the first goal[6–9)], compressive dressings such as adhesive, occlusive, Jones bandages, gauze and tape are used for the second[10)]. However, it is not always possible to apply the accelerated rehabilitation regime and dressings together, because thigh dressings may inhibit the range of motion[11, 12)] and dressings cause friction over the skin[10)]. For these reasons thigh dressings, particularly if dry, are avoided in the accelerated flexion regimes[9)]. A careful review of the literature revealed no study documenting the inhibition degrees of different types of dressings on the range of knee flexion. Accordingly, the purpose of this study was to assess the effect of different dressings on the range of knee flexion.

METHODS

Subjects

Twenty volunteers (40 knees) aged 19–24 years who did not have a history of peripheral vascular disease, vasospastic diseases or knee joint injury were recruited to the study. The mean age of the subjects was 21.8 ± 1.2 years old and 11 of them were male. Exclusion criteria included previous fracture around the knee, inflammatory arthritis, joint effusion, knee instability, and previous operations of the knee joint.

Measurements

The active range of knee motion was measured using a full-circle manual goniometer made of flexible clear plastic with arms 30 cm in length. This device fulfilled the requirements of a universal goniometer as described by Moore. The protractor portion was divided into 1° increments, and a scale on one of the arms made it possible to obtain measurements to the nearest degree[13].

Measurements were performed with the patient in the supine position. The fulcrum of the goniometer was placed over the lateral epicondyle of the femur. The stationary arm of the goniometer was placed parallel to the longitudinal axis of the femur, pointing toward the greater trochanter, and the moveable arm parallel to the longitudinal axis of the fibula, pointing toward the lateral malleolus. The patient was then instructed to move the knee to maximum flexion and the degree of flexion was measured[14].

After measuring the knee flexion with the leg bare, the same procedure was repeated after the application of elastic stockings, elastic bandages or Jones bandages. Both knees of the volunteer were dressed identically. All dressings were applied in the same doctor (VK) and all measurements were performed by the same physical therapist (BU), in the same order.

The statistical analyses were performed using SPSS for Windows (version 15.0, SPSS Inc., Chicago, Illionis). The results were evaluated by analysis of repeated measures and the Bonferroni test. A p value of < 0.05 was considered significant.

RESULTS

None of the subjects had previous disease or intervention around the knee joint. The mean body mass index was 22.8 ± 2.6 indicating that none of the subjects had obesity.

According to analysis of repeated measures and the Bonferroni test, all the external supports resulted in statistically significant restriction of the degree of knee flexion as compared to the naked knee ($p<0.05$), (Table 1). The Jones bandage appeared to inhibit the knee flexion angle by 16.8%. This value was 2.7% for elastic stockings and 4.2% for elastic bandages.

DISCUSSION

Total joint replacement is a safe and effective treatment for advanced arthritis of a knee that has not responded to nonoperative treatment[15, 16] and postoperative rehabilitation for total knee replacement (TKR) has gained in importance[2, 3, 8, 15–17]. The demands of decreasing hospital length of stay and lowering hospital costs have become paramount[8]. The continuous passive motion (CPM) machine for rapid mobilization of the operated knee joint is generally used[2, 3]. Many studies have suggested that CPM allows greater early knee flexion, decreases knee pain, shortens hospital stays, and reduces the need for manipulation[6, 9]. As such, early accelerated flexion regimes are used to obtain the benefits of CPM[6, 9].

Compression is widely used in orthopaedic surgery and rehabilitation to control swelling and pain. It is generally accepted that control of swelling can improve wound healing, reduce pain, and permit rapid rehabilitation of the knee after trauma or surgery[5]. In rehabilitation of primary TKR, rapid mobilisation of the operated joint is essential to reduce the duration and costs of rehabilitation[4]. Another important issue after TKR is reducing the swelling, because swelling can interfere with efforts to regain motion[2]. The ideal knee bandage should maintain an appropriate tension to control swelling within the joint in addition to allowing early motion without complications[18]. On the other hand it is well known that dressings provide resistance to range of motion[11, 12]. Additionally, the period of compression dressings changes from 24 hours to six weeks[2, 8, 18–20]. In order to achieve the benefits of early motion and dressings it seems necessary to make some modifications to postoperative rehabilitation programs. For this purpose, the inhibition degrees of different types of dressings on the range of motion needs to be documented, the aim of this study.

In the present study all dressings (Jones bandage, elastic stockings, and elastic bandages) inhibited joint flexion significantly (Table 1). However, the percentage of inhibition was not the same for all dressings. While the Jones bandage appeared to inhibit the knee flexion angle by 16.8%, elastic bandages and stockings inhibited knee flexion by 4.2% and 2.7%, respectively. The actual degrees of these percentages are 3.6° for elastic stockings, 5.8° for elastic bandages and 23.2° for the Jones

Table 1. Range of knee motion in the study (n=40 knees)

	Knee Flexion (°)	ROM	p-value
Naked knee	138.1 ± 3.2	(130-145)	
Elastic stockings	134.5 ± 3.4	(125-140)	,000
Elastic bandage	132.3 ± 3.6	(123-139)	,000
Jones bandage	114.9 ± 4.6	(108-126)	,000

Values are expressed as mean ± SD.
p-value: as compared with the naked knee.
ROM: range of motion.

bandage. Although these results are statistically significant as compared with the naked knee, differences less than 10 degrees are questionable[21]. Previous studies also indicated that the Jones bandage resulted in greatest pressure, while elastic stockings the least[11, 22].

The ideal knee bandage should maintain an appropriate tension to control swelling within the joint, while at the same time avoid complications such as venous obstruction and blistering of the skin[18]. Some studies have suggested that flexion exercises until bandage removal should be delayed as skin necrosis may result from movement[18, 23]. However this approach is contrary to the opinion of rapid mobilization of the operated joint which is essential to reduce the duration and costs of rehabilitation[4].

Our aim in rehabilitation following TKR should be to gain an excellent range of movement and a functional outcome without complications for each patient. In our opinion, for these reasons the results obtained in the present study may be used in the modification of the rehabilitation regime after TKR. For example, if swelling is not so important for a patient, elastic stockings may be used, but it should be kept in mind that there may be loss of motion about four degrees. However, in our opinion, a similar study should applied for TKR patients for more strict conclusions.

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