Mechanical Therapy for Loss of Knee Extension

A. Dempsey, TP Branch, T Mills, MS Albert

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A Dempsey BS[1], TP Branch MD, FAAOS[2], T Mills RN, BSN[3], MS Albert, M.Ed., PT., ATC., SCS[4]

[1] MSII Medical College of Georgia, [2] Director of University Orthopaedic Clinic, [3] Researcher, [4] Eisenhower Medical Center

Introduction:

Loss of knee extension is a frequent complication of knee surgery. Surgeries implicated in loss of extension include total knee arthroplasty (TKA), ACL reconstruction and MCL reconstruction.[1-7] The rate of postoperative stiffness following a primary TKA is between 11% and 12%. [10,11] The incidence of arthrofibrosis following ACL reconstruction is between 4 and 35%. [17]

Loss of motion caused by arthrofibrosis can be more devastating to the patient than the instability for which surgery was instituted.[16] Arthrofibrosis is managed typically by physical therapy with arthroscopic or open debridement.[7] The most effective nonoperative treatment for arthrofibrosis is early detection coupled with aggressive therapy.[4,7]

Current treatment options for arthrofibrosis following TKA, ACL reconstruction and other knee surgeries do benefit most patients, but for a small percentage of the patient population this is ineffective. Less invasive treatments could be more beneficial for patients suffering from arthrofibrosis and postoperative stiffness. Noninvasive therapy avoids the reformation of arthrofibrotic scar tissue, because the environment in which scar tissue was initially formed is not recreated.[7] **We hypothesized that the addition of home mechanical therapy (HMT) to supervised physical therapy (PT) would increase knee extension and significantly reduce the need for surgical management of knee extension loss.**

Materials and Methods:

Between January 14, 2002 and August 6, 2004 seventeen patients (12 males and 5 females) were entered into a prospective study to evaluate the effectiveness of HMT for knee extension loss. Patients who failed to attain 0˚ of extension were placed in HMT. All patients began HMT after their respective surgery or diagnosis, however time elapsed between surgery and HMT was determined by the physician with consideration given to each patient's medical history. [7] All patients used HMT until an extension of 0˚ was attained or the physician felt that the patient's extension had reached a plateau. In the study group, an average follow up was 42 weeks (range 4-121 weeks).

Patients. The mean age was 41.3 years (range 18-54 years). No patients complained of knee pain or restriction of motion in the opposite, unaffected extremity. Patient surgeries included ACL or MCL repair, meniscal resection, repair, or transplant, TKA, unicondylar knee arthroplasty (UKA), high tibial osteotomy (HTO) and use of an external fixator for a tibial plateau fracture. Mean time interval from initial surgery to the onset of HMT was 6 weeks (range 0-21 weeks). The average number of surgeries before onset of HMT was 1.71 (range 1-7).

Measurements Utilized. In this study, extension, flexion and heel height difference for the affected and unaffected knee were measured with a seven inch goniometer.

Classification of Arthrofibrosis. The patients loss of motion was classified according to the Shelbourne et al Classification Scheme for Arthrofibrosis (Table 1).[18] The patients were sorted according to extension and coinciding flexion loss. Fifteen out of eighteen patients did not qualify for the same extension and flexion loss types, and were consequently classified based on extension loss.

Type	Flexion Loss	Normal
I	Normal	<10
II	Normal	>10
III	>25	>10
IV	>30	>10 w/ patella infera

Table 1. Shelbourne Classification System

HMT Device and Protocol for Use. The ERMI Knee Extensionater (ERMI, Inc. Atlanta, Ga) was used to provide HMT (Figure 1). Load is applied to the knee by a pneumatic pressure cuff. Force is generated at the actuator by pumping a bulb which expands the air cuff. The force is controlled and produced by the patient, and can be applied in a continuum of low, medium and high magnitude. According to the HMT protocol, patients used the device for 15 minutes per session 4 to 8 times per day. During each session, patients dynamically stretched the knee to their end range of extension for 1 to 5 minutes. For recovery, they released the joint into the neutral position for an equal amount of time. The stretching/relaxing intervals are repeated for a total of 15 minutes.

Patient Improvement. Progress was quantified with the Cincinnati Knee Score (CKS) and the International Knee Documentation Committee (IKDC, 2000 Version). [19-22] Patients completed both the CKS and the IKDC surveys according to pre- and post-HMT abilities.

Statistical Analysis. Statistical analysis determined the significance of pre- and post-HMT CKS and IKDC scores as well as the significance of extension gained during HMT. A one tailed t test (assuming unequal variance) was utilized.

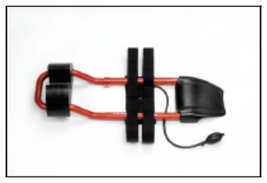

Figure 1. The ERMI Knee Extensionater

Results:

The most important finding of this study is that knee extension in our patient population increased an average of 10.7˚ (range 2-19˚) at the conclusion of HMT. Fifteen out of the seventeen patients had a final extension after HMT of 0˚. Patients with Type I, Type II and Type III arthrofibrosis all improved their extension by at least one Shelbourne Type rating. All Shelbourne Type I and II patients attained a final extension of 0˚ and ten (out of twelve) Type III patients reached 0˚ extension (Table 2). Patients were grouped according to surgery and the recovery of each surgical group was evaluated. In our population of patients, the two most prevalent surgical groups were ACL reconstruction (8 patients) and TKA (4). Every TKA and ACL reconstruction patient regained a final extension of 0˚. Patient improvement was also measured with the CKS and IKDC. Each patient improved his/her scores after HMT protocol completion (Table 4).

Initial Shelbourne Type	Before HMT	After HMT	Opposite Extremity
I	-5.00	**0.00**	0.00
II	-10.00	**0.00**	0.00
III	-13.2	**-0.13**	-0.14
IV	none	none	none

Table 2. Patient Improvement by Shelbourne Type .

		CKS			IKDC		
		Before HMT	After HMT	Change	Before HMT	After HMT	Change
Injury	TKA	132.5	308.75	**176**	3.44	34.1	**30.7**
	ACL	195.0	441.9	**256**	-7.80	43.8	**51.7**
Shelbourne Type	Type I	159.0	335.0	**176**	-2.30	32.6	**35.0**
	Type II	150.0	305.0	**155**	11.0	22.0	**11.0**
	Type III	180.9	405.0	**224**	-7.08	43.0	**50.1**

Table 4. Patient Improvement According to CKS, IKDC

Time between surgery/diagnosis and initiation of HMT was also compared with population divided into two groups. Patients in Group A began HMT less than four weeks after surgery or diagnosis. Patients in Group B began HMT four weeks or more after surgery or diagnosis.

At the conclusion of HMT, Group A had greater extension and less HHD than Group B. Additionally, CKS and IKDC scores of Group A were significantly higher than Group B (p=0. 123, p=0.320 , Table 7). **This indicates that while 88.2% of all study participants regained full extension, those who began HMT less than four weeks after surgery had a more successful recovery in terms of final extension, HHD, CKS score and IKDC score.**

	Initial Extension	Final Extension	Final HH	Initial CKS	Final CKS	Initial IKDC	Final IKDC
Group A (<4 weeks)	10.3	**0.00**	1.72	166	**421**	-4.86	**42.7**
Group B (≥4 weeks)	6.90	**-0.30**	2.70	178	**340**	-4.40	**35.9**

Table 7. Patient Improvement and Onset of HMT

Conclusion:

The most important finding is that 15 out of 17 patients (88.2%) regained an extension of 0˚ after an average of 9.1 weeks in HMT (range 1-24 weeks). All patients benefited from HMT regardless of type of surgery or pathology. All CKS and IKDC scores improved after HMT. Every ACL reconstruction and TKA patient regained full extension (0.00˚). Heel height difference revealed small flexion contractures in all patients after HMT with an overall average of 2.24cm (range 0-6). No patient required surgical intervention for extension loss. Therefore, in our patient population, HMT in conjunction with PT eliminated the need for surgical intervention to treat extension loss. It is our conclusion that patients who lack extension of the knee should be offered HMT as a preventative alternative to manipulation under anesthesia or lysis of adhesions. Additionally, patients that begin HMT earlier will have more successful recoveries.

Literature Cited:

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