

# Use of home Neuromuscular Electrical Stimulation (NMES) in first 6 weeks improves function and reduces pain after Primary Total Knee Arthroplasty.

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## Introduction

Total knee arthroplasty (TKA) is a highly effective procedure for patients who suffer from late stage knee arthritis. TKA surgery leads to significant pain reduction in majority of patients. Despite this positive outcome quadriceps femoris strength after TKA often fails to recover. Quadriceps strength can often fail to recover to levels of healthy, age-matched cohorts years after surgery . This can lead to profound functional consequences such as impairments with balance, walking speed, stair climbing , and increase fall risk. Additionally, nearly 50% of patients report impairments in physical function one year after TKA.

The use of NMES with exercise has been demonstrated to reduce pain and quadriceps muscle strength recovery in patients after TKA surgery. However, to our knowledge this has not been directly tested in patients who receive muscle stimulators for home use after surgery. Therefore, the purpose of this study is to assess the effect of NMES use at home in addition to standard therapy program in patients after TKA surgery and compare the early functional results to a matching group of Post TKA patients that did not receive home NMES units.

### Surgical procedure and Immediate post op protocol

*All surgeries underwent standard medial para-patellar approach. Bone cuts were made perpendicular to the mechanical axis with the help of an intramedullary alignment system. The proximal tibia was also cut perpendicular to the mechanical axis of the tibia with the help of extramedullary guides. All knees were closed in a standardized manner. All patella's were resurfaced. A spinal anesthetic was used for all patients. Tourniquet was not used.*

*All patients underwent the same post-operative pathway . Average length of inpatient stay was 2.3 days (2- 5 days). Following surgery each patient was given a prescription for oxycodone 5 mg q4-6 PRN pain for 4 weeks with 0 refills.*

Discharge disposition	NMES group	Matched group
Home with Outpatient PT	20	16
Home PT followed by Outpatient PT	5	6
Acute/Subacute followed by Outpatient PT	2	5

## Methods

Twenty-seven patients with Primary TKA during June 2017 to March 2018 were fitted either one week before or with in a week of surgery a home NMES devices. NMES device was Bluetooth enabled and was controlled by a smart phone (Cymedica Orthopedics, Phoenix, AZ). Patient compliance data was monitored on the cloud. Patients used the NMES device for 20 minutes 2 to 3 times a day, daily.

Functional parameters such as TUG, Single Limb stance time, time taken to ascent and descend one flight of stairs, quad lag, range of motion (ROM), 2 minute walking distance and pain rating on visual analog scale (VAS) were measured at approximately 6 weeks after surgery. This data was also obtained from a matching cohort of 27 patients from a pool of 376 patients that had TKA surgery from June 2014 to October 2015 that did not receive home NMES device. All 27 patients were matched for gender, for BMI with in 3 points, and with in 5 years for age

### Pre Surgical Clinical guidelines for dispensing NMES units

- Presence of active extension lag in sitting or doing a straight leg raise
- Greater than 33% deficit on the pre surgical side (measured by Hand Held Dynamometer)
- Knee flexion Contracture greater than 10 degrees

### Post Surgical Clinical guidelines for dispensing NMES units

- Presence of Active extension lag sitting greater than 25 -30 degrees
- Presence of Active extension lag greater than 20 degrees in straight leg raise

### Statistical analysis:

*All patient data were assessed via patient charts prior to surgery and at 6 weeks from surgery. An independent sample t-test was conducted to compare means of dependent variables. p –value >0.05 was required to accept the null hypothesis that there was no difference in variance between the two groups. All analysis were conducted using SPSS version 24 (IBM corporation, Armonk, New York)*

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Results:

- Patients in the Home NMES group had significantly better ( $P<0.05$ ) for Quad Lag, TUG, Time to ascend and descend one flight of stairs, single limb stance time and 2 minute walking distance.
- In addition 15 out of 27 patients could not use stairs reciprocally in the control group vs. only 8 patients out of Home NMES group could not.
- In addition Home NMES unit group experienced significantly less pain on VAS scale (Mean 1.33, range 0=5) as compared to matching control group experienced greater pain score on VAS scale of (Mean = 5.1 range 1-9).
- There was no significant difference in active or passive range of motion in two groups.

Significant improvement in functional tests in NMES group as compared to matching control group

Functional tests	Home NMES group	Matching Control	P value
Timed Up and go (TUG), (seconds)	12.8 (7-28)	23.3 (15 -53)	0.0005
Stair climb time, (seconds)	30.8 (16-56)	49.7 (23-100)	0.041
Single Limb Stance time, (seconds)	18.7 (6-55)	7.7 (3-21)	0.00031
Quad Lag, (degrees)	11.1 (0-20)	23 (5-40)	0.0002
2 Min walk distance (feet)	362 (195 -555)	260 (175 -350)	0.048

Significant improvement in functional test in NMES group as compared to matching control group

Pain Scores	Home NMES	Matching Control	P value
Pain VAS scale at 6 weeks from surgery	1.33 (0-5)	5.1 (1-9)	0.0480

No significant difference in range of motion between NMES group and matched control group

	Home NMES group	Matched control group	P value
AROM Flexion	93.6 (65 - 120)	88 (50 -120)	0.352
AROM Extension, (degrees) (Quad setting measurement)	-7.5 (0 - -20)	-6.5 (5--25)	0.812
PROM Flexion	103.9 (75 - 130)	94.8 (55-125)	0.0838
PROM Extension	-2.78 (0—15)	-3.9 (0—20)	0.329

Conclusion:

- This matched comparison of primary TKA patients demonstrated significant pain reduction and improved function with use of home based NMES units for the sub-acute phase of the recovery in addition to standard therapy program.
- Patients walked longer distances safely as showed by improvement in TUG, Quad lag and single limb support time.
- Larger proportions of patients in home NMES group were able to negotiate stairs reciprocally and faster than the matched control group.
- There have been efforts aimed at reducing therapy costs. A customary target in these efforts has been to cut down on post-acute care therapy visits and costs . Due to this many patients may be fitted towards a physical therapy regimen that falls short of their expected functional outcomes.
- Our study demonstrated significant improvements in functional outcomes and reduction in pain when home based NMES therapy was utilized in addition to standard therapy. Our study is of clinical significance and may warrant discussion on models best aimed at reducing costs while optimizing patient outcome during the post-acute period by employing Home based NMES therapy in addition to standard therapy.
- Further randomized larger sample trials are needed to prove efficacy of Home based NMES therapy as an adjunct to standard of care therapy regime for post surgical management of Primary TKA patients.