Neuromuscular Electrical Stimulation and Quadriceps Strength Following Patellar Fracture and Open Reduction Internal Fixation Surgery: A Case Report

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Background and Purpose

- Patellar fractures account for approximately 1% of all fractures and are most common in people who are 20 to 50 years old.[1] Comminuted patellar fractures occur when the bone shatters into three or more pieces and is usually caused by a direct blow to the knee.[1] Open reduction internal fixation (ORIF) surgery is typically needed if the bone is broken into three or more pieces near the center of the patella.[1]
- Quadriceps weakness is common following this type of injury and surgery, and the literature reflects varying opinions as to what is the best method for regaining strength.
- The purpose of this case report was to examine the use of neuromuscular electrical stimulation (NMES) in conjunction with traditional exercises for strengthening the quadriceps following atrophy status post ORIF surgery for a comminuted patellar fracture.

A. Radiograph of comminuted patellar fracture

B. ORIF after comminuted patellar fracture

Case Description

- This patient was a 28 year-old female status post left comminuted patellar fracture and ORIF surgery after crashing into a tree while snow skiing.
- She presented to physical therapy (PT) with quadriceps weakness among other impairments. She was treated with NMES in addition to traditional land and pool strengthening exercises for the quadriceps approximately three times per week for three weeks.

C. Comparison of both legs showing quadriceps atrophy on the left

D. Close up of left knee showing scar and bruising

Interventions

The patient was seen for a total of eight treatment sessions, which included five land-based sessions and three aquatic-based sessions. The land and aquatic interventions in the tables below were chosen to increase strength and decrease atrophy of the left quadriceps. She was also given a home exercise program (HEP) on the first day and received a home electrical stimulation unit to supplement what was being done in PT.

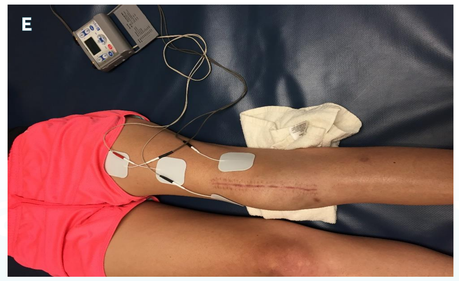
Quadriceps Strengthening Interventions on Land

Intervention	Week 1 (1 session)	Week 2 (2 sessions)	Week 3 (2 sessions)
Neuromuscular electrical stimulation	Empi Continuum NMES PPR 1 x 10 minutes	Empi Continuum NMES PPR 1 x 10 minutes early in the week and x 20 minutes later in the week	Empi Continuum NMES PPR 1 x 20 minutes
Quadriceps sets	x 10	x 10 without NMES early in the week and x 10 with NMES later in the week	x 10 with NMES
4-way strait leg raises	x 10 each	X 12 each	x 10 with NMES early in the week and x 12 with NMES later in the week
Partial wall squats	x 10	x 10	x 12
Step-ups	Not performed	4" x 10	6" x 20

NMES= neuromuscular electrical stimulation, PPR= pre-program

Quadriceps Strengthening Exercises in Pool

Intervention	Week 2 (2 sessions)	Week 3 (1 session)
Side step with squat	2 laps	2 laps
Bicycle	1 lap	2 laps
Squats at ladder	x 10	x 12
Step-ups	8" x 10	8" x 12



E. Empi Continuum NMES and electrode placement

Outcomes

The patient's quadriceps manual muscle testing (MMT) score improved from 3+/5 (slightly greater than fair) at initial examination to 4/5 (good) approximately three weeks later. Circumferential measurements of the left lower extremity (LE) also improved as she was able to reverse quadriceps atrophy and inflammation decreased. Specifically, the circumferential measurement for the left quadriceps was 41 cm upon initial examination and increased to 42 cm within three weeks. She also reported an 18% increase in function after three weeks of PT according to her Lower Extremity Functional Scale (LEFS) score.

Outcomes Related to Quadriceps Strengthening

Tests and Measures	Initial Examination Results	Re-evaluation Results: 3 Weeks after Initial Examination
Manual Muscle Testing	Quadriceps: 3+/5	4/5
Edema/Circumference	Mid-patella: 37 cm	36 cm
	5 cm above: 36.5 cm	36.5 cm
	15 cm above: 41 cm	42 cm
Lower Extremity Functional Scale	30% function bilaterally	48% function bilaterally

Discussion

- Overall, this case appeared to have a successful outcome and the purpose of this case report was met as demonstrated by the increased quadriceps MMT score following strengthening exercises in conjunction with NMES.
- Positive factors most likely associated with the outcomes of this case report included motivation, family support, and the therapy provided.
- These findings suggest that NMES in conjunction with traditional quadriceps strengthening exercises may have had the ability to improve quadriceps strength in this individual status post comminuted patellar fracture and ORIF surgery.

Conclusions

- As far as implications for future clinical practice, in conjunction with further investigation, NMES may be beneficial in increasing quadriceps strength for patients with this type of injury and surgery. Further research is needed to validate the outcome of this intervention.
- Additional research that could be beneficial for this patient population is examining the efficacy of quadriceps strengthening exercises alone, without the use of NMES. It would be interesting to see how this compares to NMES in conjunction with strengthening exercises, like what was done in this case report.
- It would also be beneficial to examine the efficacy of common stretching exercises in regards to range of motion. Findings in these areas could help address common impairments that occur as a result of a comminuted patellar fracture and ORIF surgery which could improve the quality of life for this patient population.

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References

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