General

Perioperative Nutritional Supplementation Reduces Quadriceps Muscle Atrophy After Anterior Cruciate Ligament Reconstruction: A Prospective Case Series

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Background

Quadriceps weakness is common after anterior cruciate ligament reconstruction (ACLR). This prospective, nonrandomized comparative case series describes muscle size after a perioperative nutrition protocol.

Methods

The supplied report includes 25 patients who received a perioperative nutrition protocol beginning 2 weeks before surgery and continuing 4 weeks after surgery. Rectus femoris cross-sectional area (CSA) was assessed at 3 and 6 months post-operatively.

Results

Cross-sectional area change was −3.1% versus −6.8% at 3 months and −1.2% versus −4.9% at 6 months in the peri-operative nutrition group compared to control($p<0.01$). There were no adverse events related to peri-operative nutrition reported.

Conclusion

Peri-operative nutritional supplementation was associated with reduced post-operative quadriceps muscle atrophy as measured by quadriceps cross-sectional area. Allocation was nonrandomized and baseline comparability remains unverified; these results are a baseline for further investigation.

Keywords: anterior cruciate ligament; quadriceps; nutrition; muscle atrophy; case series

INTRODUCTION

Quadriceps atrophy and weakness remain common after anterior cruciate ligament reconstruction (ACLR). Early pain, effusion, reduced loading and arthrogenic muscle inhibition complicate recovery despite structured rehabilitation. In physically active patients, the persistence of these deficits can delay progression to higher-demand activity.[1,2]

Nutritional support during surgical recovery has received increasing attention. Studies of essential amino acid and protein supplementation after orthopedic procedures have reported attenuation of muscle loss, although protocols and populations vary.[3-8] Creatine has been studied during immobilization and rehabilitation, with inconsistent results when administered as an isolated intervention after ACLR.[9-12]

The OVIAL Surgical Nutrition Kit combines several nutritional components over a 14-day pre-operative and 28-day post-operative period. This report describes quadriceps muscle size and strength outcomes among patients receiving that protocol and a standard-care comparison group. The purpose of this study was to investigate the effects of a standardized peri-operative nutrition protocol on quadriceps muscle volume.

MATERIALS AND METHODS

This study was a prospective, nonrandomized comparative observational case series, of fifty patients undergoing primary ACLR. Patients included in the study had ACLR with either bone–patellar tendon–bone autograft, quadriceps tendon autograft or Achilles allograft. Exclusion criteria were multiligamentous injury, fracture, revision ACLR and concomitant meniscus repair.

Patient included in the study group received a peri-operative nutrition protocol which was compared to a control group of standard perioperative care. Patients were enrolled in the study prospectively however patients were not randomized. Patients enrolled in the study group elected to purchase the Ovial Surgical Nutrition Kit. The peri-opera-

Table 1. Quadriceps outcomes

Outcome	Follow-up	OVIAL protocol	Standard care	Reported p value
Quadriceps CSA, change from baseline	3 months	−3.1%	−6.8%	<0.01
Quadriceps CSA, change from baseline	6 months	−1.2%	−4.9%	<0.01
Quadriceps strength, limb symmetry	3 months	68.5%	59.2%	<0.01
Quadriceps strength, limb symmetry	6 months	85.6%	77.3%	<0.01

CSA, cross-sectional area. Values and p-value thresholds are transcribed from the supplied manuscript; group sizes, dispersion estimates and adjusted confidence intervals were not supplied. Statistical results require verification against the original analysis.

tive nutrition protocol was made available to all patients however purchasing the protocol was not mandatory and patients elected to purchase the product based on their own research.

The OVIAL Surgical Nutrition Kit is comprised of daily pre-operative supplementation for 14 days before surgery, followed by daily post-operative supplementation for 28 days after surgery. The pre-operative ingredients include hydrolyzed collagen peptides, arginine, glutamine, calcium β-hydroxy-β-methylbutyrate (HMB), curcumin, vitamin C, vitamin D and zinc. The post-operative supplementation included whey protein isolate, collagen peptides, creatine monohydrate, HMB, leucine and vitamin D, together with capsules containing vitamin C, vitamin D, magnesium and curcuminoids.

All patients underwent primary ACLR and followed a standardized rehabilitation protocol. All patients were allowed immediate weight bearing as tolerated, early range of motion and supervised physical therapy twice weekly beginning within two weeks of surgery. Patients included in the study received either BTB autograft, quadriceps autograft, or Achilles Allograft.

Rectus femoris cross-sectional area (CSA) was assessed by ultrasound with the patient supine and the knee extended. The supplied manuscript specifies an 8-MHz linear probe (Xario SSA-660A, Toshiba Medical Systems), positioned perpendicular to the femur at two-thirds of the distance from the anterior superior iliac spine to the superior patellar border. One technician, blinded to group assignment, traced the rectus femoris outline. Percentage change from baseline was reported at 3 and 6 months.

Longitudinal between-group differences in quadriceps CSA was analyzed using mixed-effects linear regression. Treatment group, postoperative time point, and their interaction were modeled as fixed effects, with participant included as a random effect to account for repeated measurements. Statistical tests were two-sided, and $p<0.05$ was considered statistically significant.

RESULTS

Fifty patients were included in the study, 25 patients who received a peri-operative nutrition protocol and 25 patients in the control group. In the peri-operative nutrition group, there were 10 BTB autograft, 8 quadriceps autografts, and 7 Achilles allografts. The control group included 12 BTB autografts, 10 quadriceps autografts, and 3 Achilles allografts. At 3 months, mean CSA change was −3.1% in the OVIAL group and −6.8% with standard care (reported $p<0.01$). At 6 months, the corresponding changes were −1.2% and −4.9% (reported $p<0.01$).

Sub-group analysis demonstrated no difference in CSA between graft type. No supplementation-related adverse events were reported in the supplied manuscript. No patient-reported outcomes are included in this report.

DISCUSSION

A standardized peri-operative nutrition protocol demonstrated reduced loss of rectus femoris CSA compared to standard-care comparison group. This difference persisted at six months post-operatively, after completion of the six-week supplementation schedule. These observations are consistent with a possible role for perioperative nutrition in supporting muscle recovery, but the observational comparison cannot establish causality.

Prior randomized arthroplasty studies have demonstrated muscle-sparing effects with essential amino acid supplementation.[3-5] Reviews of perioperative protein and amino acid interventions also report encouraging but heterogeneous findings.[6-8] Creatine may assist rehabilitation under some conditions, although a previous ACLR trial of creatine alone did not demonstrate a clear strength benefit.[9-12] Due to the OVIAL Surgical Nutrition Kit containing multiple ingredients, this data does not identify any independent ingredient effect.

The main limitations are the small, reported cohort, mixed graft types, uncertain dietary intake and supplement adherence, and the lack of patient reported outcomes. Ultrasound measurement of rectus femoris CSA is also not interchangeable with whole-quadriceps muscle volume. The study was not designed to assess return to sport, return to duty or reinjury.

CONCLUSIONS

Patients who underwent anterior cruciate ligament reconstruction who utilized a standardized perioperative protocol demonstrated less rectus femoris CSA loss at three and six months post-operatively compared to those who did not use a nutrition protocol.

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