

ORIGINAL ARTICLE

TO COMPARE THE EFFECT OF PRICE PROTOCOL IN 120° KNEE FLEXION IMMOBILIZATION AND WITHOUT 120° KNEE FLEXION IMMOBILIZATION IN TEN MINUTES FOLLOWING GRADE II QUADRICEPS CONTUSION

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ABSTRACT: INTRODUCTION: Contusion injuries to the quadriceps are common in athletes, in fact next to muscle strains. The severity of the quadriceps contusion is almost always underestimated and is usually undertreated. P.R.I.C.E Protocol is the universal protocol which is used in quadriceps contusions. We undertook a randomised control study to assess the effect of PRICE protocol with mild stretching, isometrics and ROM exercises to reduce pain and increase ROM in 120° knee flexion immobilization and without 120° knee flexion immobilization in ten minutes following Grade II quadriceps contusion in athletes. **METHODOLOGY:** 30 patients with grade II quadriceps contusion in athletes were randomly allotted into two groups – one receiving PRICE protocol with knee immobilized in 120 degrees flexion, while the other group was not immobilized in flexion. Knee range of movements, functional evaluation by "lower extremity functional score" (LEFS), and pain was evaluated using visual analog scale (VAS) on day 1, 7 and 14 and was statistically evaluated. **RESULTS:** Knee flexion range of motion is improved in both groups but group A patients which are treated with PRICE protocol with 120 degrees knee flexion immobilization showed statistically highly significant improvement than group B samples who were treated with PRICE protocol without 120 degrees knee flexion immobilization. P<0.01. Lower extremity functional scores showed improvement in both groups but group A who were treated with PRICE protocol with 120 degrees knee flexion immobilization showed statistically highly significant improvement than group B samples who were treated with PRICE protocol without 120 degrees knee flexion immobilization. P<0.01. VAS scale is improved in both groups but group A who were treated with PRICE protocol with 120 degrees with 120 degrees knee flexion showed highly significant improvement than group B samples who were treated with PRICE protocol without 120 degrees immobilization. P<0.01. **CONCLUSION:** we conclude that PRICE protocol with 120 degrees knee flexion immobilization is more effective than PRICE protocol without knee flexion immobilization in 120 degrees in the treatment of grade II quadriceps contusion so the hypothesis is proven as highly significant. **KEYWORDS:** quadriceps contusion, PRICE protocol, lower extremity functional score (LEFS).

INTRODUCTION: Acute injuries to the thigh are common and represent approximately 10% of all sports injuries. Contusion injuries to the quadriceps are common in athletes, in fact next to muscle strains.¹ Quadriceps contusion is due to a severe direct hit or a traumatic blow to the thigh resulting in various amounts of bleeding and muscle tissue damage. This causes deep rupture to the muscle tissue and hemorrhage occurs at intra and inter muscular region which is followed by inflammation. This condition is also known as corked thigh, dead leg and Charley Horse.² The severity of the quadriceps contusion is almost always underestimated and is usually undertreated.

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The commonest site of injury is the anterior and lateral thigh, and the disability depends on the severity of the bleeding, the amount of muscle crushed, and the experience of the physician and therapist treating the injury.³ The extent of a quadriceps contusion is based on a variety of factors, including the amount of force occurring during injury.⁴ The most readily recognizable physical sign that correlates with increasing severity of muscle injury is the initial loss of range of motion. This feature can be coupled with degree of pain and swelling to assign a severity level with reasonable accuracy.⁵

Classification of Quadriceps Contusions: Quadriceps injuries are classified based on the available knee ROM at 12-24 hours after the injury. Jackson and Feagin originally described a classification system, which was further modified by Ryan et al.⁶

Grade I Mild: Greater than 90° with normal gait and localized tenderness;

Grade II Moderate: 45° to 90° with antalgic gait and swollen, tender mass in the quadriceps;

Grade III Severe: Less than 45° with severely antalgic gait and a noticeably swollen and tender mass.

P.R.I.C.E Protocol⁷: Is the universal protocol which is used in quadriceps contusions. It is expanded as Protection, rest, ice, compression, elevation.

Treatment⁸: There are various physiotherapy treatment techniques available for treating Grade II quadriceps contusion, out of which the PRICE protocol along with mild stretching, isometrics and ROM exercises has a major role in reducing the contusion within 24 hours. This protocol along with immobilization in 120 degrees of knee flexion proves to be of value in aiding the athlete regain full flexibility.

Immobilization in Quadriceps Contusions: It is recommended that the injured leg be placed in a position of flexion for the first 24 hours post-injury to limit hematoma formation. Practically, this can be done by placing the patient in a hinged knee brace at 120° of knee flexion or using elastic compression wrap to maintain this position of flexion. This needs to be done as soon as possible after injury. Besides maintaining this position of flexion, ice and compression should be applied during this time. Several military studies have demonstrated the efficacy of this acute phase treatment of quadriceps contusions.

Normal knee flexion is typically the slowest parameter to return after thigh contusions. For this reason, Jackson and Feagin's protocol recommends placing the knee and hip in flexion (120 degrees at the knee) for the first 24-48 hours only. Aronen advocates placing the knee in immediate passive knee flexion to 120 degrees with icing within 10 minutes of injury and maintains this for 24-48 hours as needed. This position of flexion places the quadriceps under tension and may lessen intramuscular bleeding. This maximizes stretching of the quadriceps and decreases flexion loss.^{6,9,10}

Objectives of the Study:

1. To assess the effect of PRICE protocol with mild stretching, isometrics and ROM exercises to reduce pain and increase ROM in 120° knee flexion immobilization and without 120° knee flexion immobilization in ten minutes following Grade II quadriceps contusion in athletes.

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2. To assess the effect on the Lower Extremity Functional Evaluation Scale in 120° knee flexion immobilization and without 120° knee flexion immobilization in ten minutes following Grade II quadriceps contusion in athletes.

MATERIAL AND METHODS: Subjects were selected for the study if they fulfilled the following inclusion criteria and exclusion criteria: Table 1.

Inclusion Criteria	Exclusion Criteria
grade II quadriceps contusions	grade I, III
inability to perform pain free quadriceps contraction	grade II with avulsion fractures
inability to perform SLR (straight leg raise), in grade II	associated degenerative joint disease
	with any old fracture of femur
	with piriformis syndrome and hamstring pull
	with open wounds or skin abrasions

Table 1

Sampling Technique: Random sampling technique was chosen for this study. Subjects were divided in two groups by simple random selection. Group A and Group B with each group consisting of 15 patients. The patients in Group A were given immobilization of hip and knee in 120° flexion with compression bandage within ten minutes after injury for 24 hours. PRICE protocol was followed for 24-48 hours followed by mild stretching; isometrics and ROM exercises for 14 days. The patients in Group B were not immobilized in 120° of flexion within ten minutes following injury. PRICE protocol was followed for 24-48 hours followed by mild stretching, isometrics and ROM exercises for 14 days.

Assessment of pain by the Visual Analog Scale [VAS].¹¹ Measurement of Range of Motion [ROM] was done with a goniometer. Measurement of the Disability was done with Lower Extremity Functional Score^{12, 13}

Intervention consisted of PRICE protocol for 24- 48 hours. Icing (ice towel technique) was given in the supine position with the knee immobilized in 120° of flexion in Group A and in Group B with the knee in extended position. This was done for 20 minutes every 2 hours. After 48 hours stretching exercises and isometrics were given. Initially 3 sets of 5 repetitions (15 minutes) then followed to 3 sets of 10 repetitions (20 minutes) were given. When the patient was able to do 30 pain free repetitions he started using ankle weights for added resistance. Treatment was given once a day for 14 days. Assessments were done on the day of injury, day 7 and day 14. The data was statistically analyzed using repeated measures of ANOVA test, Karl Pearson correlation coefficient and Mauchly's Chi- square test.

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RESULTS:

	Group A, n (%)	Group B, n (%)	Total, n (%)
17-18 years	8(53.3%)	5(33.3%)	13(43.3%)
19-20 years	5(33.3%)	6(40.0%)	11(36.7%)
21-22 years	2(13.3%)	4(26.7%)	6(20%)
Total	15(100%)	15(100%)	30(100%)
Left	7(46.7%)	8(53.3%)	15(50.0%)
Right	8(53.3%)	7(46.7%)	15(50.0%)

Table 2: Age and side of involvement of subjects

No significant difference was found between the groups with respect to age ($p=0.484$) or the side of involvement ($P=0.714$).

Parameter	Group	N	Min	Max	Mean	S. D	ANOVA	P
Knee ROM	A	15	48	80	61.53	10.521	0.749	0.46 NS
	B	15	46	88	64.80	13.224		
	Total	30	46	88	63.17	11.859		
LEFS	A	15	45	58	52.47	4.033	1.872	0.072 NS
	B	15	39	52	49.93	3.348		
	Total	30	39	58	51.20	3.863		
VAS	A	15	5	10	7.67	1.345	0.422	0.676 NS
	B	15	5	9	7.87	1.246		
	Total	30	5	10	7.77	1.278		

Table 3: comparison of Day 1 assessment between the groups

There is no significant difference between the groups with respect to all the parameters at Day 1 as p value in all the cases >0.05 .

		Min	Max	Mean	S.D	ANOVA	p
Group A	Day 1	48	80	61.53	10.521	238.859	0.000
	Day 7	90	112	98.8	7.331		HS
	Day 14	109	120	117	4.326		
Group B	Day 1	46	88	64.8	13.224	212.174	0.000
	Day 7	80	115	96.93	10.025		HS
	Day 14	97	120	108.6	110		

Table 4: Day 1, Day 7 and Day 14 comparison in Group A and Group B (Knee ROM)

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Group	(I)	(J)	Mean diff (I-J)	Std. Error	% change	P value
Group A	Day 1	Day 7	-37.267	3.149	60.56	<0.01 (HS)
		Day 14	-55.467	2.708	90.14	<0.01 (HS)
	Day 7	Day 14	-18.200	1.682	18.42	<0.01 (HS)
Group B	Day 1	Day 7	-32.133	2.865	49.59	<0.01 (HS)
		Day 14	-43.800	2.226	67.59	<0.01 (HS)
	Day 7	Day 14	-11.667	1.178	12.04	<0.01 (HS)

Table 5: Pairwise Comparison of Knee range of motion

ANOVA for repeated measures and pairwise comparison by Bonferroni test showed that there is high significant increase in range of motion in group A and group B, all $p < 0.01$. In group A change was 60.56% at day 7 and 90.14% at day 14. Whereas, in group B change was 49.59% at day 7 and 67.59% at day 14.

So both the groups show significant increase in knee ROM, both are effective.

Change		Mean diff	S.D	% change	t value	p
day 1-7	Grp A	32.27	12.198	60.56	1.206	0.238 (NS)
	Grp B	32.13	11.096	49.59		
Day 1 -14	Grp A	55.47	10.487	90.14	3.328	0.002 (HS)
	Grp B	43.80	8.621	67.59		
Day 7-14	Grp A	18.20	6.516	18.42	3.181	0.004 (HS)
	Grp B	11.67	4.562	12.04		

Table 6: Comparison of effect between the groups (Parameter: knee range of motion)

Amount of change in Group A and Group B was not significantly different at Day 1 to Day 7 as $p > 0.05$, But highly significant at Day 14 as $p < 0.01$.

So Group A shows higher improvement than Group B. Group A is more effective compared to group B.

		Min	Max	Mean	S.D	ANOVA	p
Group A	Day 1	45	58	52.47	4.033	607.127	<0.01 (HS)
	Day 7	60	68	65.27	2.963		
	Day 14	70	78	75	3.000		
Group B	Day 1	39	52	49.93	3.348	552.504	<0.01 (HS)
	Day 7	58	62	60.53	1.685		
	Day 14	69	74	70.80	1.146		

Table 7: Day 1, day 7 and day 14 comparison in group A and group B (LEFS)

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Group	(I)	(J)	Mean diff (I-J)	Std. Error	% change	P
Group A	Day 1	Day 7	-12.800	.812	24.4	<0.01 (HS)
		Day 14	-22.533	.761	42.95	<0.01 (HS)
	Day 7	Day 14	-9.733	.153	14.91	<0.01 (HS)
Group B	Day 1	Day 7	-10.600	.689	21.23	<0.01 (HS)
		Day 14	-20.867	.755	41.79	<0.01 (HS)
	Day 7	Day 14	-10.267	.371	16.69	<0.01 (HS)

Table 8: Pairwise comparison (Lower extremity functional scale)

ANOVA for repeated measures and pairwise comparison by Bonferroni test shows that there is high significant increase in Lower Extremity Functional Score in Group A and Group B, all $p < 0.01$. In Group A change was 24.4% at day 7 and 42.95% at day 14. Whereas in Group B, change was 21.2% at day 7 and 41.7% at day 14.

So both the groups showed significant increase in LEFS, both are effective.

Change		Mean diff	S.D	% change	t value	p
day 1-7	Grp A	12.80	3.144	24.40	2.067	0.048(SIG)
	Grp B	10.60	2.667	21.23		
Day 1 -14	Grp A	22.53	2.949	42.95	1.554	.131(NS)
	Grp B	20.87	2.924	41.79		
Day 7-14	Grp A	9.73	.594	14.91	1.328	.195(NS)
	Grp B	10.27	1.438	16.96		

Table 9: Comparison of effect between the groups (LEFS)

Amount of change in group A and Group B was statistically significant. The difference at day 1 to day 7 as well as at day 14 was $p < 0.05$. Since Group A shows higher improvement than Group B, Group A is more effective compare to Group B.

Group		Min	Max	Mean	S.D	ANOVA	p
Group A	Day 1	5	10	7.67	1.345	202.912	<0.01 (HS)
	Day 7	1	6	3.80	1.474		
	Day 14	0	2	.27	.594		
Group B	Day 1	5	9	7.87	1.246	292.569	<0.01 (HS)
	Day 7	4	6	4.40	.632		
	Day 14	0	2	.73	.799		

Table 10: Day 1, day 7 and day 14 comparison in group A and group B (VAS)

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Group	(I)	(J)	Mean diff (I-J)	Std. Error	% change	P value
Grp A	Day 1	Day 7	3.867	.376	50.43	<0.01 (HS)
		Day 14	7.400	.335	96.52	<0.01 (HS)
	Day 7	Day 14	3.533	.389	92.98	<0.01 (HS)
Grp B	Day 1	Day 7	3.467	.350	44.07	<0.01 (HS)
		Day 14	7.133	.307	44.07	<0.01 (HS)
	Day 7	Day 14	3.667	.211	83.33	<0.01 (HS)

Table 11: Pairwise comparison (Visual analogue scale)

ANOVA for repeated measures and pairwise comparison by Bonferroni test shows that there is high significant decrease in pain level in Group A and Group B, all $p < 0.01$. In Group A decrease was 50.4% at day 7 and 96.5% at day 14. Whereas, in Group B decrease was 44.07% at day 7 and 90.68% at day 14.

So both the groups showed significant decrease in pain, both are effective.

Change		Mean diff	S. D	% change	t value	p
day 1-7	Grp A	3.87	1.457	50.43	.778	.443(NS)
	Grp B	3.47	1.356	44.07		
Day 1 -14	Grp A	7.40	1.298	96.52	.587	.562(NS)
	Grp B	7.13	1.187	90.68		
Day 7-14	Grp A	3.53	1.506	92.98	.302	.765(NS)
	Grp B	3.67	.816	83.33		

Table 12: Comparison of effect between the groups (VAS)

Amount of change in Group A and Group B was not statistically significant. The difference at day 1 to day 7 as well as at day 14 was $p > 0.05$.

So both the groups are equally effective in reducing the pain.

DISCUSSION: The chief objective of this study was to compare the efficacy of treating grade II quadriceps contusions with PRICE protocol with immobilization of knee in 120 degrees versus treatment with PRICE protocol without 120 degrees knee immobilization in reducing the pain intensity and improving the range of motion and lower limb function were assessed by VAS, ROM and LEFS respectively. The study was detailed and tailored to find which mode of treatment was better in the two groups after 14 days of treatment.

The statistical analysis was done for both the groups and showed reduction in pain intensity with improvements in range of motion and lower extremity function score in Group A.

Age wise distribution in group A and group B majority of patients 53.3% were in the age group of 17-18 years, 33.3% of patients were in the age group of 19- 20 years and 13.3% of patients were in the age of 21-22 years respectively.

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Both the groups showed reduction in pain levels but Group A showed higher significant difference than Group B. VAS showed significant difference between the groups.

Group A in which PRICE protocol with knee flexion immobilization in 120 degrees showed high significant reduction in pain than Group B. It was concluded that VAS is more responsive than a current pain measure, even when the time reference is shortened to the last 24 hours. This result is important because in acute conditions or conditions from which patients recover quickly, it may be unreasonable to ask patients to judge their average pain over a period as long as 2 weeks as stated by Scrimshaw s.v. et al.¹⁴

The goniometry measurements showed that there is an increase range of motion in pre and post treatment within the groups and between the groups respectively. Further between the groups the knee flexion range of motion improved more significantly in Group A than in Group B. These improvements were seen due to the maintaining of the position of 120 degrees of flexion, ice and compression applied during this time. Normal knee flexion is typically the slowest parameter to return after thigh contusions. This position of knee flexion in 120 degrees places the quadriceps under tension and may lessen intramuscular bleeding. This maximizes stretching of the quadriceps and decreases flexion loss shown by Aronen JG, Garrick JG, Chronister RD, Mc Devitt ER.⁹

The Lower Extremity Function Scores showed an increase in the pre and post treatment scores of lower limb function in both the groups but a higher significant increase was seen in Group A as compared to Group B. This proves that The Lower Extremity Function Score is not only easy to administer and score it is applicable to a wide range of disability levels and conditions and all lower-extremity sites. The LEFS is more interpretable with respect to understanding error associated measurement and for determining minimally clinically important score changes and is a sufficient measure of reliability, validity, and sensitivity to change, at a level that is commensurate with utilization at an individual patient level. The LEFS can be used by clinicians as a measure of patients' initial function, ongoing progress, and outcome as well as to set functional goals.¹³

CONCLUSION: Knee flexion range of motion is improved in both groups but group A patients which are treated with PRICE protocol with 120 degrees knee flexion immobilization showed statistically highly significant improvement than group B samples who were treated with PRICE protocol without 120 degrees knee flexion immobilization. $P < 0.01$.

Lower extremity functional scores showed improvement in both groups but group A who were treated with PRICE protocol with 120 degrees knee flexion immobilization showed statistically highly significant improvement than group B samples who were treated with PRICE protocol without 120 degrees knee flexion immobilization. $P < 0.01$.

VAS scale is improved in both groups but group A who were treated with PRICE protocol with 120 degrees with 120 degrees knee flexion showed highly significant improvement than group B samples who were treated with PRICE protocol without 120 degrees immobilization. $P < 0.01$.

Hereby we conclude that PRICE protocol with 120 degrees knee flexion immobilization is more effective than PRICE protocol without knee flexion immobilization in 120 degrees in the treatment of grade II quadriceps contusion so the hypothesis is proven as highly significant.

Limitations of the Study:

1. Female samples were not available to be included in the study.
2. Ages of the athletes/sportspeople included in this study were between 17-22 years of age. It is debatable if older athletes will be able to recover and regain their flexibility in the 14 days protocol.
3. There may be difficulty in maintaining 120 degrees of flexion immobilization with cryotherapy and it may pose to be a difficulty in the outcome.

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