To the Graduate Council:

I am submitting herewith a thesis written by Scott A. Sall entitled "Ice Therapy as a Means of Reducing Delayed Muscle Soreness." I have examined the final copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Physical Education.

David R. Bassett, Jr.

David R. Bassett, Major Professor

We have read this thesis and recommend its acceptance:

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Accepted for the Council:

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Vice Provost
and Dean of The Graduate School

ICE THERAPY
AS A MEANS OF REDUCING
DELAYED ONSET MUSCLE SORENESS

A Thesis
Presented for the
Master of Science
Degree
The University of Tennessee, Knoxville

Scott A. Sall

August 1989

Dedicated to

My Father
for his strength, support and love

My Mother
for her patience, love and prayers

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Finally, thanks and reverence to my Lord who gave me the opportunity and talent to achieve my goals. (Proverbs 3:5)

Abstract

A comparison of a cryotherapy treatment vs. a placebo control was investigated to determine their effectiveness in the reduction of delayed onset muscle soreness (DOMS). Eight healthy, non-weightlifting volunteers (four male/four female) performed eccentric contractions of the arm flexor muscles using the Nautilus Double Biceps machine beginning at an intensity equal to 110% of the maximum concentric strength. The work load was maintained until it was impossible to control the descent of the weights for three seconds. At that time the weight was decreased by five pounds and exercise was continued. This pattern was continued until a minimum load of twenty pounds or fifteen minutes of constant work was achieved. Upon completion of the exercise, an ice pack was applied to one randomly selected arm with the other receiving the placebo.

Subjective soreness, pressure application soreness, range of motion, and arm circumference were recorded immediately before exercise and at 24, 48, and 72 hours post-exercise.

Repeated measures ANOVA found no significant difference between treatments ($P < 0.05$). Significant differences were found between days for subjective soreness, pressure application soreness and range of motion. A Pearson Product Moment Correlation Coefficient was calculated and no

significant correlation existed between ROM and circumference measures ($P > .05$).

It was concluded that ice alone could not alleviate the conditions associated with DOMS in this study.

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CHAPTER I

INTRODUCTION

Exercise imposed on untrained muscle results in the development of delayed onset muscle soreness (DOMS). DOMS usually lasts up to seventy-two hours, with peak soreness most evident twenty-four to forty eight hours after exercise (35). Symptoms associated with DOMS are muscle stiffness, tenderness, inflammation and pain. Active movements and passive lengthening are painful and usually avoided (2, 25, 39).

The effects of various therapeutic modalities such as aspirin (17, 28, 34,), non-steroidal anti-inflammatories (11, 15), prostaglandin-inhibiting drugs (6, 30, 34), transcutaneous electrical stimulation (12, 14), static stretching (13), and cryotherapy (8, 9, 10, 16, 22, 26, 31, 32, 33, 41) have been studied. Relative to the prevention of the pain, swelling and inflammation that accompanies DOMS and/or other sport related injuries, the most common treatment of any exercise induced soft-tissue injury is cryotherapy (27, 33).

Cryotherapy is the application of a cold substance, usually ice, to a joint, muscle, or the skin to reduce swelling, pain, bleeding, or inflammation. Researchers have studied the effects of cryotherapy on skin temperature, subcutaneous tissue temperature, intra-muscular temperature, intra-articular temperature and blood flow for the purpose of advancing the understanding of the physiological effects associated with this therapeutic modality. The general consensus is that cryotherapy is an effective means of reducing the acute pain, edema and inflammation associated with such acute injuries as muscle strains, ligament sprains, skin burns, etc. (27, 33). Other physiological actions attributed to cryotherapy include: vasoconstriction, decrease in blood flow, reduction of muscle spasm, and decrease in nerve conduction velocity (33).

Two previous studies looked at the effects of cryotherapy in the reduction of muscle damage and/or delayed onset muscle soreness resulting from eccentric exercise. Braun and Clarkson (9) studied the effects of cryotherapy administered prior to and during an eccentric exercise bout. One arm received the treatment while the other served as the control. There were no significant effects on measured variables (strength, relaxed elbow angle, flexed elbow angle and CK) due to the treatment and the authors concluded that cryotherapy did not reduce the damage response to exercise. A second study by Yackzan et al. (41) looked at the effectiveness of ice massage in the reduction of DOMS. They administered the treatment to three groups; one immediately post-exercise, the second at twenty-four hours post-exercise and the third at forty-eight hours post-exercise. They also concluded the ice massage did not yield any significant effect in the reduction of DOMS.

The differences one finds when looking at the effectiveness of cryotherapy as it is used in acute soft-tissue injuries, i.e. strains, sprains and burns (10, 16, 22 27, 33) and DOMS research studies (9, 41) is very interesting. Yackzan et al. suggested: "there is a great need for additional well controlled studies to determine the effects of cold application on the physiological responses in deep tissues and to correlate these effects with practical clinical applications." Therefore, in order to extend the work of Braun and Clarkson, and Yackzan et al., this study was developed with the intent to collect data that support cryotherapy as an effective means of reducing DOMS.

It was hypothesized that the cryotherapy treatment would result in less soreness, greater ROM, and less increase in circumference in the treated arm when compared to the control arm. In an attempt to control for psychological variables favoring treatment over a non-treatment control, this study introduced a placebo that was described to the subjects as a therapeutic cream which was being studied along with the ice treatment.

CHAPTER II

METHODOLOGY

SUBJECTS: The subjects used in this study were volunteers from the student body of the University of Tennessee. There were four males and four females. Their mean age, weight, and height can be found in Table 1. Informed consent was obtained prior to each experiment in accordance with the University of Tennessee Committee on Research Participation.

PROTOCOL: Delayed onset muscle soreness was experimentally induced by having the subjects perform eccentric contractions of the arm flexor muscles using the Nautilus Double Biceps weight training apparatus. This machine consists of an adjustable seat which allows the subject to obtain a correct position to concentrate the work onto the biceps muscle group. The arms are extended and placed across an arm rest. The correct position is assumed when the shoulder height is slightly above the elbow height, thus limiting any contribution of muscle power from the deltoids and/or inhibiting the possibility of using excess leverage during the exercise.

A one repetition maximum (1 RM), defined as the maximum amount of weight the subject can lift only one time from the

Table 1. Subject Characteristics (Mean ± Standard Deviation)

Subject	Age(yrs)	Height(inches)	Weight(lbs)
No. 1	23	72.00	170
No. 2	20	71.75	167
No. 3	19	67.50	130
No. 4	40	70.50	237
No. 5	23	74.00	195
No. 6	21	64.00	112
No. 7	21	64.00	135
No. 8	22	64.50	128
Mean ± SD	23.6 ± 6.7	68.53 ± 4.0	159.25 ± 41.6

extended position, was obtained on each subject. Ten percent of the 1 RM weight, to the nearest five pound increment, was added to the load and the subject began exercise at that work load (3). The subject performed only eccentric contractions, with the investigator returning the weight to the subject's flexed position (start position). On counts one, two and three the subject lowered the weights simultaneously with both arms to the fully extended position and on count four the investigator returned the weights to the start position. The rhythmic count was set by a standard metronome at sixty counts per minute. When the subject was no longer able to control the descent of the weights (i.e. resist the weight for the three count to the fully extended position) the weight load was decreased by five pounds. This procedure was followed until the work load reached 20 pounds or fifteen minutes had elapsed.

TREATMENT: Upon completion of the exercise bout, the subject was seated in a chair positioned between two tables. The subject's arms were placed on the tables so that they were elevated to heart level. An ice pack was then placed on a randomly selected arm, with the alternate arm receiving the placebo treatment. The placebo consisted of a non-aromatic skin creme, which was described as a therapeutic modality that was being tested with the ice treatment. The ice pack was positioned so that it covered the entire biceps musculature. The ice and creme remained in place for fifteen minutes, after which they were removed for fifteen minutes. A second treatment period was then initiated for another fifteen minutes. This method of treatment was based on the suggestion by Kellett (27) that cryotherapy for 10-20 minutes, 2 to 4 times per day is helpful in promoting early return to full activity following an acute sprain or strain. At the end of the second treatment period the subjects were instructed to refrain from aspirin, anti-inflammatory medication, massage therapy, stretching or any physical activity that may enhance or diminish the side effects associated with the exercise bout.

MEASUREMENTS: The measurements recorded included: subjective soreness (S), pressure application soreness (PA), range of motion (ROM), and arm circumference in centimeters (CIRC). Measurements were recorded immediately prior to the exercise bout and at twenty-four, forty-eight, and seventy-two hours after the exercise bout.

Soreness evaluations were recorded as a number which represented a described sensation according to a scale developed by Talag (Table 2). A subjective soreness rating was recorded. Subjective soreness for this study was defined as the overall soreness felt during the course of daily activity. Pressure application soreness was measured in

Table 2. Talag's soreness scale (Talag, 1973)

RATING	PERCEPTION OF SORENESS
0	NO SORENESS
1	BARELY NOTICEABLE
2	NOTICEABLE
3	UNCOMFORTABLE
4	PAINFUL
5	VERY PAINFUL
6	UNBEARABLE

response to a spring loaded pressure applicator similar to the one used by Newham (35). It applied a direct force of twenty Newtons to one square centimeter of surface area. The site used was the distal end (tendinous attachment) of the brachialis.

Range of motion measurements were recorded with a standard three hundred and sixty degree full circle goniometer. The subject was asked to place the arm in a horizontally abducted position with the forearm supinated. With the elbow joint used as the point of origin, the humerus and radius were the lines of reference to determine the range of motion in degrees.

Arm circumference was measured to monitor changes in swelling and/or inflammation. On each arm, a point sixteen centimeters from the olecranon process was marked with an indelible marker. This point of reference was used each day. Measurements were made using a cloth measuring tape. It should be noted that for every subject, the same investigator recorded all measurements to eliminate the possibility of error due to different techniques.

STATISTICAL ANALYSIS: A two-way repeated measures ANOVA (factor 1 = treatment, factor 2 = days) was used to identify differences between treatments and days. Duncan's Multiple

Range Test was used to identify differences between days. A $P < .05$ was accepted as statistically significant. The Method of Least Squares was used to calculate Pearson Product Moment Correlation Coefficient for ROM and circumference measures. Again, a $P < .05$ was accepted as statistically significant.

CHAPTER III

RESULTS

SUBJECTIVE SORENESS: For subjective soreness, (Figure 1, APPENDIX A-1) day 0 was significantly different from days 1, 2 and 3 ($P < .05$). Days 2 and 3 were not significantly different from each other, but were significantly from day 1 ($p < .05$). Subjective soreness scores were highest at forty-eight hours post-exercise. Greatest changes in subjective soreness took place between days 0 and 1.

PRESSURE APPLICATION SORENESS: For pressure application soreness, (Figure 2, APPENDIX A-2) day 0 was significantly different from days 1, 2 and 3 ($P < .05$). Days 1, 2 and 3, however, were not significantly different from each other. Pressure application soreness peaked at forty-eight hours post-exercise and, again, greatest changes took place between days 0 and 1.

RANGE OF MOTION: For ROM, (Figure 3, APPENDIX A-3) day 0 was significantly different from days 1, 2 and 3 ($P < .05$). Day 1 was also significantly different from days 2 and 3 ($P < .05$). Days 2 and 3 were not significantly different from each other. The greatest changes took place between days 0

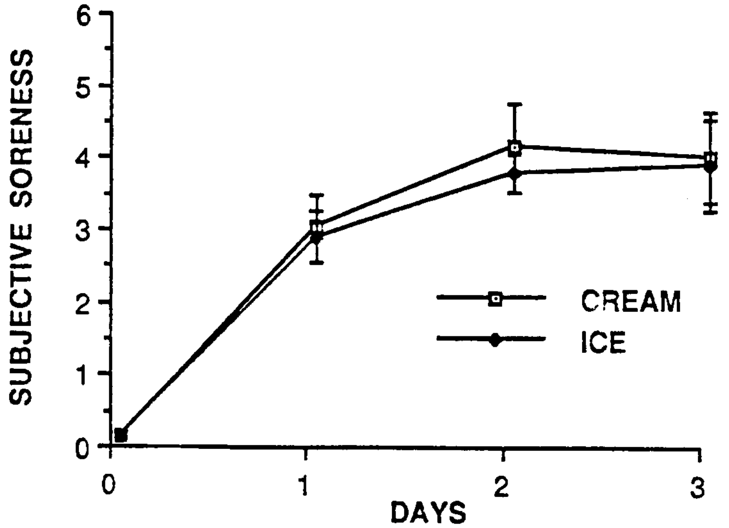

FIGURE 1. EFFECTS OF ICE ON MEAN SUBJECTIVE SORENESS (N=8). VALUES REPRESENT MEAN ± SE.

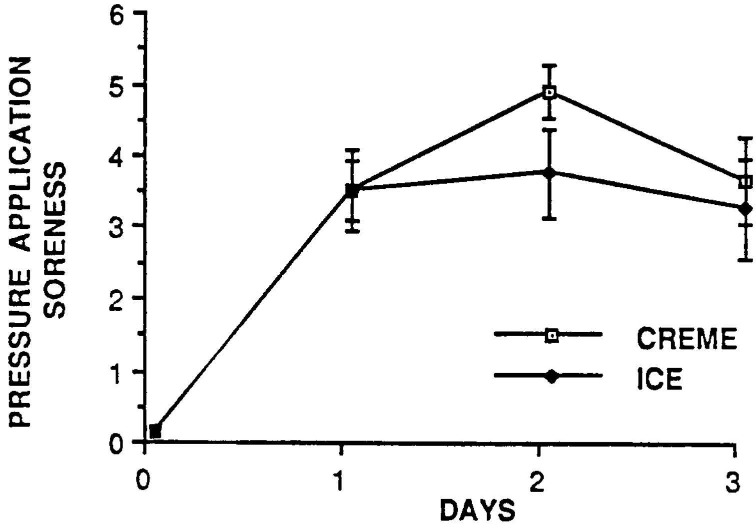

FIGURE 2. EFFECTS OF ICE ON MEAN PRESSURE APPLICATION SORENESS (N=8). VALUES REPRESENT MEAN ± SE.

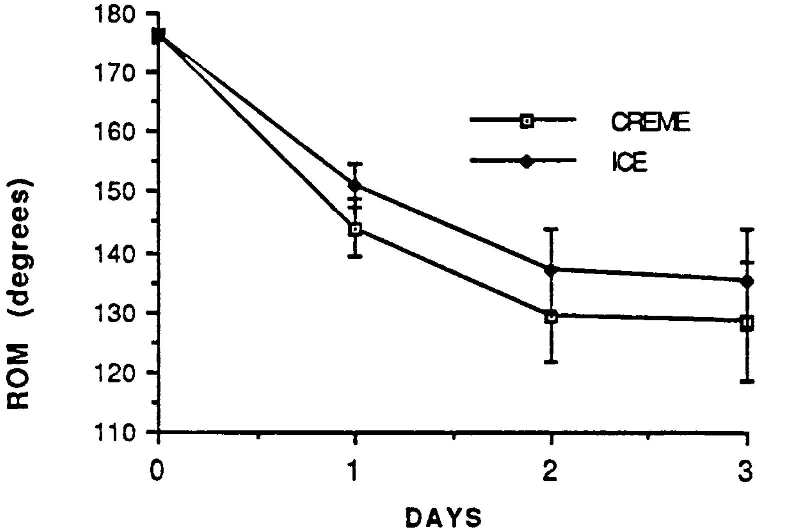

FIGURE 3. EFFECTS OF ICE ON MEAN ROM (N=8).
VALUES REPRESENT MEAN ± SE.

and 1 and ROM values reached their lowest point at seventy-two hours.

CIRCUMFERENCE: For circumference, there was no significant difference found between any days (Figure 4, APPENDIX A-4). Circumference measures were greatest at seventy-two hours post-exercise.

ROM/CIRC CORRELATION: There appeared to be a correlation between increasing arm circumference and decreasing ROM. A Pearson Product Moment Correlation Coefficient (Figure 5, APPENDIX A-6) was calculated to be -0.33 and was not significant ($P > .05$).

Repeated measures analysis of variance yielded no significant difference between treatments, however, a significant difference between days was noted. Duncan's Multiple Range Test was used to locate the difference between days.

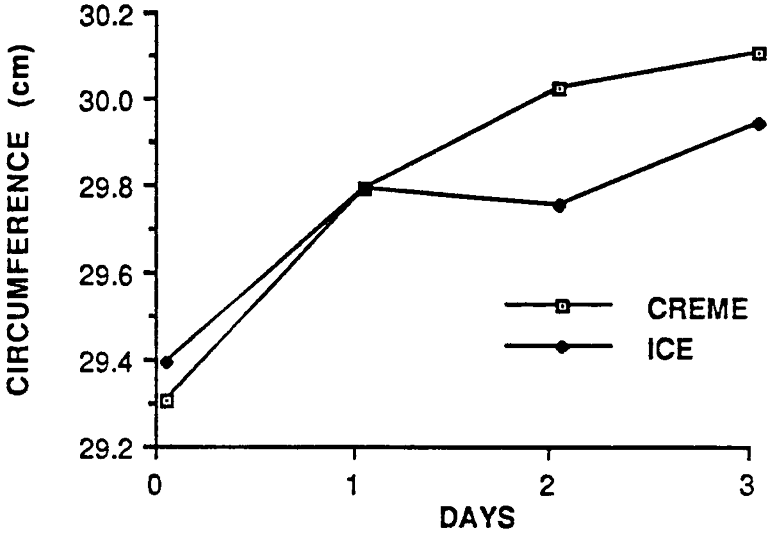

FIGURE 4. EFFECTS OF ICE ON MEAN ARM CIRCUMFERENCE IN CM (N=8). VALUES REPRESENT THE MEAN OF EACH GROUP.

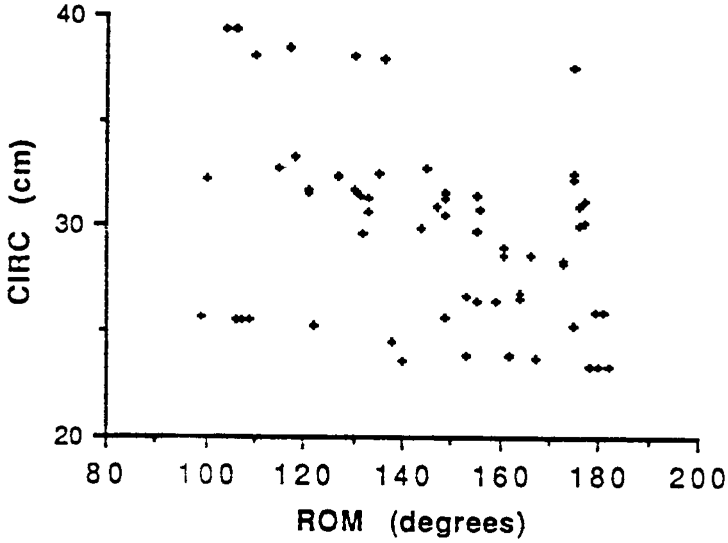

FIGURE 5. PEARSON PRODUCT MOMENT COEFFICIENT CORRELATION (P > .05).

CHAPTER IV

DISCUSSION

The primary purpose of this study was to investigate the therapeutic effects of a cryotherapy treatment versus a placebo in terms of reducing DOMS. The variables studied included changes in subjective soreness, point soreness, ROM and circumference measurements. The subjects who were involved in this study were "active" (i.e. swimmers, runners), but not involved in any current and/or recent (6 months) strength training program.

Delayed onset muscle soreness is a phenomenon which has been studied since the turn of the century (25). Since that time, the factors that contribute to DOMS have been debated. The basic theories include: the muscle spasm theory, the torn tissue theory, the damaged connective tissue theory, and inflammation. These theories have been both supported and disputed as the underlying cause contributing to DOMS. The purpose of this investigation was not to debate which theory holds most merit, but rather to determine whether cryotherapy is an effective means of reducing DOMS.

The exercise protocol was effective in producing soreness as indicated by the significant changes in subjective soreness scores up through seventy-two hours post exercise. However, three subjects (two male and 1 female) complained of elevated soreness levels ninety-four to one hundred twenty hours post exercise.

The increase in pain in the exercised arms, found in this study, agrees with the available literature (1 ,2, 13, 39, 41) that eccentric exercise produces DOMS. Peak soreness (Figure 1) was evident at 48-72 hours post exercise which is also consistent with the literature (35). Five subjects found the protocol to be adequate in its ability to produce soreness and did not suffer from any long term (greater than 72 hours) side effects. Three subjects, however, experienced extreme pain and decreased ROM as well as extensive swelling of the distal tendinous attachments of the biceps brachii and brachialis. Although three of the subjects complained of excessive pain and discomfort, it is apparent by the mean subjective soreness and pressure application soreness scores that this protocol induced soreness that was in the mid-range of Talag's soreness scale (Table 2) and therefore should be considered "treatable." If the mean soreness response was "5" or greater, then this protocol would be considered too intense for the purpose of the study. However, the moderate scores (peak soreness of 3.8 for "S" and 4.1 for "PA") lead this investigator to conclude that this protocol was adequate.

With the pressure applicator, (Figure 2) peak soreness was evident at twenty-four hours post-exercise with no significant difference found between days 1 through 3. Seven of the eight subjects stated that the greatest pain was felt in the distal tendinous attachment area of the forearm flexors. One subject, however, noted the greatest soreness in the muscle belly midway between the proximal and distal attachments. The pressure application soreness scores were recorded in this study simply as a second soreness reference. No statistical comparisons were made between the two soreness variables, however. The idea of the pressure applicator was modeled after a pressure applicator used by Newham et al. (35). This study used a force equal to 20N of force applied to a 1 square cm surface area.

Range of motion (Figure 3) decreased significantly with an increase in delayed onset muscle soreness up to forty-eight hours post-exercise as was similarly reported by Yackzan et al. (41). There appears to be a trend of increasing arm circumference between days (Table A-6). A Pearson Product Moment Correlation Coefficient was calculated to be -0.33 and was not significant ($P > .05$) for ROM and circumference. While it was not significant, there is a tendency for a negative correlation between ROM and arm circumference measures, but without statistical significance we are unable to draw any definitive conclusions from this study.

Support for a correlation between increased circumference measures and decreased ROM can be found in Friden et al. (20). That investigation correlated the morphological changes that take place after eccentric exercise with intramuscular pressure changes. The subjects in the study were asked to exercise their right lower leg anterior compartment eccentrically and their left concentrically. Tissue fluid pressures were measured by the slit catheter technique before, during, and after exercise and forty-eight hours later. Needle biopsies of both anterior tibialis muscles were taken at forty-eight hours post exercise and revealed a greater cross-sectional fiber area in the eccentrically exercised muscle. The percentage of water content was also found to be higher in the eccentrically exercised muscle. They concluded muscle fiber swelling is a predominant feature following eccentric exercise and is directly associated with DOMS.

If one were to look at the four DOMS theories that were stated earlier, according to the pain responses in this study, one would have to strongly consider the damaged connective tissue theory as the most contributing factor to the decreased ROM. This statement is supported by the fact that seven of the eight subjects stated that most of the soreness and pain were located in the distal tendinous attachment area of the forearm flexors. The eighth subject stated most of the soreness was in the muscle belly area of the forearm flexors but also noted less pronounced soreness in the tendinous attachment area.

This study was different from other cryotherapy studies in that it introduced a placebo control. The idea for the placebo was developed with the intent that it would "control" for any psychological bias a subject may have when rating soreness in the treated and untreated limbs. It is possible that the subject may presume that although both limbs are sore, since one limb received a treatment (ice), it should not have as much soreness as the untreated limb. Also, ice has become the accepted therapeutic treatment for acute injuries (33). This common knowledge may influence a subject's perception of the amount of soreness. Therefore, the placebo was introduced to each subject as a therapeutic modality that was being investigated along with the cryotherapy. When questioned after the study as to whether they believed that one treatment was more effective than the other, all subjects responded "no." Based on that, the placebo control may be beneficial in future cryotherapy studies as a means of controlling the psychological factor.

According to the information collected in this study, it is reasonable to assume that cryotherapy alone did not effectively reduce the DOMS associated with this exercise protocol. Quite possibly the answer to the question "What reduces the symptoms associated with DOMS?" lies in the combination of two or more therapeutic modalities.

CHAPTER V

CONCLUSIONS

1. Cryotherapy was not effective in reducing DOMS as a result of eccentric exercise when compared to a placebo (creme) treatment.

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APPENDIX A

APPENDIX A-1. Repeated Measures ANOVA for Variable "S".

Source	DF	Sum of Squares
Model	4	153.81
Error	59	93.62
Corrected Total	63	247.43

Source	DF	Type I SS	F	P
Treat	1	.25	.16	.69
Day	3	153.56	32.26	.0001

APPENDIX A-2. Repeated Measures ANOVA for Variable "PA".

Source	DF	Sum of Squares
Model	4	167.56
Error	59	107.37
Corrected Total	63	274.93

Source	DF	Type 1 SS	F	P
Treat	1	2.25	1.24	.27
Day	3	165.31	30.28	.0001

APPENDIX A-3. Repeated Measures ANOVA for Variable "ROM".

Source	DF	Sum of Squares
Model	4	20978.81
Error	59	17729.62
Corrected Total	63	38708.43

Source	DF	Type 1 SS	F	P
Treat	1	462.25	1.54	.2198
Day	3	20516.56	22.76	.0001

APPENDIX A-4. Repeated Measures ANOVA for Variable CIRC.

Source	DF	Sum of Squares
Model	4	4.20
Error	59	1210.07
Corrected Total	63	1214.27

Source	DF	Type 1 SS	F	P
Treat	1	.113	.01	.9408
Day	3	4.09	.07	.9775

APPENDIX A-5. Raw scores of individual data.

Subject	Day	Treatment	S	PA	ROM	CIRC.
1	0	ICE	0	0	175	32.2
1	1	ICE	4	3	145	32.8
1	2	ICE	4	5	127	32.4
1	3	ICE	6	4	118	33.3
1	0	CRM	0	0	175	32.5
1	1	CRM	4	3	135	32.5
1	2	CRM	5	5	115	32.8
1	3	CRM	6	4	100	32.3
2	0	ICE	0	0	176	31.0
2	1	ICE	2	3	156	30.9
2	2	ICE	4	3	147	31.0
2	3	ICE	2	2	149	31.4
2	0	CRM	0	0	176	30.1
2	1	CRM	2	3	149	30.6
2	2	CRM	5	5	133	30.7
2	3	CRM	3	3	130	31.7
3	0	ICE	0	0	179	26.0
3	1	ICE	3	4	155	26.5
3	2	ICE	2	4	164	26.8
3	3	ICE	2	3	164	26.6
3	0	CRM	0	0	181	26.0
3	1	CRM	4	4	159	26.5
3	2	CRM	3	4	155	26.5
3	3	CRM	4	3	153	26.7
4	0	ICE	0	0	175	37.5
4	1	ICE	2	5	136	37.9
4	2	ICE	4	4	117	38.4
4	3	ICE	5	5	110	38.0
4	0	CRM	0	0	175	37.5
4	1	CRM	4	5	130	38.0
4	2	CRM	5	6	106	39.3
4	3	CRM	5	5	104	39.4

APPENDIX A-5. (cont'd).

Subject	Day	Treatment	S	PA	ROM	CIRC.
5	0	ICE	0	0	177	31.2
5	1	ICE	3	3	155	31.5
5	2	ICE	4	4	131	31.5
5	4	ICE	4	5	133	31.4
5	0	CRM	0	0	177	31.2
5	1	CRM	4	3	149	31.6
5	2	CRM	5	5	121	31.7
5	3	CRM	4	5	121	31.6
6	0	ICE	0	0	175	25.3
6	1	ICE	1	4	149	25.7
6	2	ICE	4	6	109	25.6
6	3	ICE	5	5	106	25.6
6	0	CRM	0	0	175	25.3
6	1	CRM	1	5	122	25.3
6	2	CRM	5	6	107	25.6
6	3	CRM	5	5	99	25.7
7	0	ICE	0	0	173	28.4
7	1	ICE	3	4	161	29.0
7	2	ICE	3	3	161	28.6
7	3	ICE	1	1	166	28.6
7	0	CRM	0	0	173	28.3
7	1	CRM	3	4	155	29.8
7	2	CRM	4	4	132	29.7
7	3	CRM	3	3	144	29.9
8	0	ICE	0	0	182	23.4
8	1	ICE	4	1	162	23.9
8	2	ICE	4	0	140	23.6
8	3	ICE	5	0	138	24.5
8	0	CRM	0	0	180	23.4
8	1	CRM	1	0	153	23.9
8	2	CRM	0	3	167	23.7
8	3	CRM	0	0	178	23.4

APPENDIX A-6. Correlation Analysis.

Variable	N	Mean	SD
ROM	64	147.50	24.76
CIRC	64	29.74	4.39

Pearson Correlation Coefficient:

	ROM	CIRC
ROM	1.000	-0.3335
CIRC	-0.3335	1.000

APPENDIX A-7. Soreness values for cream and ice treatment for days 0 (initial values) and 1 through 3 (post-exercise values). Values are means $\pm$ SD from Talag's soreness scale.

Treatment	N	Day	Mean	SD
Cream	8	0	0.0	0.0
Cream	8	1	2.87	1.35
Cream	8	2	4.00	1.77
Cream	8	3	3.75	1.83
Ice	8	0	0.0	0.0
Ice	8	1	2.75	1.04
Ice	8	2	3.63	.744
Ice	8	3	3.75	1.83

APPENDIX A-8. PA values for cream and ice treatment for days 0 (initial values) and 1 through 3 (post-exercise values). Values are means ± SD from Talag's soreness scale.

Treatment	N	Day	Mean	SD
Cream	8	0	0.0	0.0
Cream	8	1	3.37	1.59
Cream	8	2	4.75	1.03
Cream	8	3	3.50	1.69
Ice	8	0	0.0	0.0
Ice	8	1	3.37	1.18
Ice	8	2	3.62	1.76
Ice	8	3	3.12	1.95

APPENDIX A-9. ROM values for cream and ice treatment for days 0 (initial values) and 1 through 3 (post-exercise values). Values are means ± SD as measured by a full circle 360 degree standard goniometer.

Treatment	N	Day	Mean	SD
Cream	8	0	176.50	2.72
Cream	8	1	144.00	13.29
Cream	8	2	129.50	22.09
Cream	8	3	128.62	28.36
Ice	8	0	176.50	2.82
Ice	8	1	151.12	9.87
Ice	8	2	137.00	19.76
Ice	8	3	135.50	23.18

APPENDIX A-10. Circumference values for cream and ice treatment for days 0 (initial values) and 1 through 3 (post-exercise values). Values are means ± SD in cm. as measured by a cloth measuring tape.

Treatment	N	Day	Mean	SD
Cream	8	0	29.28	4.54
Cream	8	1	29.77	4.54
Cream	8	2	30.00	4.91
Cream	8	3	30.08	4.95
Ice	8	0	29.37	4.54
Ice	8	1	29.77	4.50
Ice	8	2	29.73	4.65
Ice	8	3	29.92	4.50

APPENDIX B

CONSENT FORM

In order to more safely carry on an exercise program, I hereby consent, voluntarily, to participate in an exercise study. The purpose of this study is to investigate the effects of two therapeutic modalities (ice vs. creme) in their roles pertaining to the reduction of muscle soreness. I shall perform eccentric contractions of the arm flexor muscles at a work load equal to one hundred ten percent (110%) of my maximal concentric strength to induce muscular soreness. At the end of the test, ice and creme will be applied to one arm each. Continual treatment will last for one hour in twenty minute intervals of on/off application. This test may be stopped at any time because of objective signs of fatigue or when the desired effect has been attained. I understand that I may stop the test at any time because of my feelings of fatigue or discomfort, or for any other personal reasons. The benefit of this experiment is knowledge of the effectiveness of either one of these treatments in reducing delayed muscle soreness.

I understand the risks of this testing procedure may include momentary elevated blood pressure and muscle soreness. I further understand that selection and supervision of my task is a matter of professional judgement.

The study will take four days to complete. On the first day, I will be given a form and asked to rate my muscle soreness, have range of motion measured, and then perform approximately 15 minutes of eccentric contractions. Immediately after the exercise, I will be administered two separate treatments, one to each arm, and asked to apply those treatments for a total of forty minutes over a one hour time period. At selected time intervals I will be asked to rate my soreness according to a scale designed for that purpose. Soreness ratings for the two treatments will be tallied and evaluated.

I understand that information from my task may be used for research projects and publications. All data collected from this experiment will be maintained in a locked cabinet file in the advisors office and only the advisor and principal investigator will have access to these files. I understand that my identity will not be revealed and that I may withdraw my consent at any time.

Any questions regarding procedures and or results can be directed to:

Scott A. Sall
HPER Building
Office 349
974-5111

Signature of subject:______________________________ Date:________

Witness:______________________________ Date:________

VITA

Scott Alan Sall was born in Chicago, Illinois, on November 30, 1965. He attended St. Celestine's Grammar School and was graduated from Holy Cross High School in May 1983. He entered Triton Community College in August 1983 and transfered to Carson-Newman College where he received a Bachelor of Science degree in health, physical education and recreation in December 1987.

In August 1988 he entered The Graduate School of the University of Tennessee, Knoxville to begin studies in exercise physiology while employed as a graduate teaching assistant in the Department of Human Performance and Sport Studies. He received his Master of Science degree with a major in physical education in the area of exercise physiology.

Following graduation, he was employed by a cardiac rehabilitation consulting firm in a management position at a medical center in Franklin, Tennessee.