

ABSTRACT

JOHNSTON, L. D. The effects of functional isometric weight training in conjunction with dynamic weight training on two bench press measurement tests. MS in Human Performance, December 1995, 90pp. (R. Pein)

The purpose of this research was to determine the difference between dynamic resistance exercises and isometrics, and dynamic resistance exercises only on two bench press tests. The experimental groups' (dynamic and isometric) test results were compared to the dynamic weight training group. Two measurement tests for the bench press used were the traditional touch and go bench press test and the dead stop and press test. Both tests were done at 1-RM for a pre- and posttest. Twenty-four college males between 18-30 years of age volunteered to participate. After both tests were completed for the pretest, the subjects lifted for a 10 week training cycle. The data from these measurement tests were analyzed with a MANOVA. Both training groups' pre- and posttest measurement scores were analyzed to observe any difference in strength gains between the two groups. The experimental group had a significant ($p < .05$) improvement in strength gain for both bench press measurements compared to the group that used traditional weight training methods.

THE EFFECTS OF FUNCTIONAL ISOMETRIC WEIGHT TRAINING
IN CONJUNCTION WITH DYNAMIC WEIGHT TRAINING ON
TWO BENCH PRESS MEASUREMENT TESTS

A THESIS PRESENTED
TO
THE GRADUATE FACULTY
UNIVERSITY OF WISCONSIN LA-CROSSE

IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE
MASTER OF SCIENCE DEGREE

BY
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DECEMBER 1995

COLLEGE OF HEALTH, PHYSICAL EDUCATION, AND RECREATION
UNIVERSITY OF WISCONSIN-LA CROSSE

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of this candidate's requirements of this degree:

Master of Science Degree in Human Performance

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ACKNOWLEDGEMENTS

I wish to thank and express my appreciation to the following persons:

To my committee members for their time, effort, and positive attitudes. Dr. Richard Pein, my thesis chairman, for his patience and guidance. Dr. Abdul Elfessi for his help with all statistical procedures and for helping me if I had any problems. Dr. William Floyd for his time and helpful insights in the revision of my thesis.

To Mr. Roger Harring for letting me use the students in his Monday and Wednesday morning weight training class as subjects for my thesis.

To Mr. Greg Lonning for letting me use the students in his Tuesday and Thursday morning weight training class as subjects for my thesis.

To all the individuals who participated in this study, I would like to extend my gratitude.

And lastly to my family: Roy, Carol, Lori, and Becky. Even though we were physically miles apart, they were an encouragement to me every time I spoke to them. They have always been there for me and I dedicate this thesis to them.

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CHAPTER I

INTRODUCTION

In the late 1960's isometrics was the most popular strength training modality. Isometric exercises strengthened specific joint angles, but did not strengthen the entire muscle through its full range of motion (Ioseliani, 1975). Conversely, the use of dynamic resistance exercises strengthened the muscle through its entire range of motion, but stick points limited the amount of weight that could be lifted. A stick point referred to the joint angle position of a movement where mechanical advantage was at the lowest point and therefore limited the total amount of weight which could be lifted (Kraemer & Fleck, 1987). When both isometrics and dynamic weight lifting exercises were used, strength gains were observed and the stick points were reduced (Jackson, Jackson, Hnatek, & West, 1985). Performance of isometric training at the sticking point may have increased strength at the joint angle of lowest mechanical advantage and aided in improved performance of the lift.

Athletes who strived to break records in various sports, or in weightlifting contests had one central component in common. They combined different training

techniques to achieve their goal. Elite strength athletes used various types of lifting programs and trained with multiple meso-cycles to improve on their weaknesses. However, isometrics were viewed as ineffective to build strength and were generally not incorporated into strength programs. Kraemer and Fleck (1987) stated that dynamic exercises were best for achieving the most absolute strength gains compared to any other type of training modality, but the amount of weight used in training was limited by the stick point. Initially the lifter's performance improved and strength gains were made with the use of dynamic exercises, but in later stages of training strength gains were not as consistent. This failure to lift a heavier amount of weight may have been caused by a sticking point.

The use of functional isometrics helped develop strength at one point in the range of motion of an exercise, but not through the muscles entire range of motion (Hoffman, Stauffer, & Jackson, 1979). Dynamic exercises developed strength throughout the muscles entire range of motion, but stick points limited the amount of weight that could be used. Perhaps when these two types of training were combined, stick points would be reduced and the weight lifted would increase.

From the early 1960's to late 1980's, research was conducted using isometrics and dynamic weight lifting exercises (Berger, 1962; Jackson et al., 1985; O'Shea,

1989). While Berger (1962) used the bench press and O'Shea (1989) used the squat exercise, the training principles were similar. Both of these researchers found a significant difference in the group that used the combined (isometric and dynamic) training program, compared to the group that used only dynamic weight lifting exercises. Berger (1962) reported a 20% increase in gained strength for the subjects who used both isometrics and dynamic lifting exercises.

Athletes have tried various types of dynamic exercises to increase the 1-RM of the bench press exercise. Since isometrics were not commonly used by many elite strength athletes, they were not often utilized even though this type of training might help reduce stick points. By conducting this study, this researcher wanted to determine if there were any benefits to combining isometrics and dynamic exercises in a lifting program.

For this training study, the traditional 1-RM bench press technique was used and a dead stop bench press test was added. It was felt that the dead stop and press test would be more sensitive to stick points compared to the traditional bench press test. Also, the use of isometrics in a functional weight training program would make this study more ecological and useful to individuals who wanted to learn how to train this way.

Previous research (Berger, 1962; O'Shea, 1989) used limited training exercises besides the core lift which they

used as their test measurement. In O'Shea's (1989) study the squat exercise was used as the measurement for the study. In the squat exercise subjects position themselves under a weighted bar in a rack which held the weight. Then the subject stepped away from the rack with the bar on their back, and set themselves in a stable position with the weight evenly spread over their feet. When ready, the subject would bend at the hips and knees until their thighs were slightly below parallel, and then the subject would slowly rise up in a standing upright position. Then the subject would step toward the squat rack and replace the weighted bar on the squat rack stands. The research by Berger (1962) and Jackson et al. (1985) used the touch and go bench press exercise (see Appendix A). In this study the touch and go bench press (TG) and the dead stop bench press (DS) measurements were used (see Appendix A).

Need for the Study

Previous research had been conducted on the effectiveness of isometric exercises when building strength (Chui, 1964; Clarke & Henry, 1961; Lhind, 1979; Tucker, 1957). Isometrics did not build strength throughout the muscle's entire range of motion and lactic acid build up in the muscles caused increased muscle soreness compared to dynamic resistance exercises. The use of isometrics has diminished since they were viewed as having limited ability to strengthen the entire muscle being trained. On the other

hand, dynamic resistance exercises were used to gain increased strength and build strength throughout the full range of motion of the muscle; but stick points at particular joint angles limited the amount of weight that could be lifted. Dynamic exercises were superior for building absolute strength in the muscles of the body compared to isometrics. The weakest link of the joint which was at the stick point determined how much weight could be lifted in the particular exercise. At the same time, studies have been done (Berger, 1962; O'Shea, 1989) which combined isometrics and dynamic lifting for the squat and bench press. Berger (1962) used the touch and go bench test; he did not use the dead stop bench press test. In this study the touch and go (TG) bench press test and dead stop (DS) bench press test were used (see Appendix A). The DS test would be more sensitive to stick points compared to the traditional TG test. The DS press measurement did not have momentum built up in the bar as it was pressed upward until the lifter's arms were locked out. TG measurement had a slight rebounding effect as the weight rebounded off the lifter's chest and pressed upward until the lifters' arms were completely extended. The results of this study may help to add important insight about combined lifting programs to encourage other strength athletes to use combined weight lifting programs.

Statement of the Problem

The purpose of this investigation was to determine the difference between dynamic resistance exercises and isometrics, and dynamic resistance exercises only on two bench press tests.

Null Hypothesis

1. There would be no significant difference between the combined (dynamic and isometric) training group and dynamic weight training group on the two bench press measurement tests.

Assumptions

1. This researcher assumed that only healthy subjects were involved in this study.
2. These individuals were free of injury to the upper extremities.
3. The subjects in this study were interested and exerted maximal effort during the training sessions.
4. All of the subjects performed both of the 1-RM max tests to the best of their ability.
5. The subjects did not perform any type of exercise 24 hours prior to the max tests.
6. The subjects followed the pre- and posttest instructions.

Delimitations

The delimitations of this study were:

1. The male subjects ($N = 24$) were volunteers and UW-La Crosse students.
2. Individuals in this experiment had at least 3 months of weight training experience.
3. The subjects were not participating in their sport season at the time of data collection.

Limitations

The limitations of this study were:

1. The lack of a basic foundation of strength at the start of this study limited the amount of potential strength gain.
2. There was no control over the subjects' motivation and attitude during the 10 week training session or the tests.
3. The subjects might have lifted outside of the class.
4. The subjects did not follow the workout exactly.

Definitions of Terms

Dynamic Exercises - this involved lifting a weight in which the joint of articulation moved through 180 degrees of motion (Kraemer & Fleck, 1987).

Functional Isometrics - these exercises worked a specific joint angle, which was the place in the joint action where the mechanical advantage was the lowest (Hoffman et al., 1979).

Range of Motion - this referred to the ability of the muscle to move from a completely extended position to a flexed position. Most joint actions require the muscle to move the entire 180 degree range of motion (McIntosh, 1974).

Stick Point - this was defined as a point of joint position in a movement where the mechanical advantage was at its lowest point (Kraemer & Fleck, 1987).

Volume of Work - the number of times the lifting movement was to be done (repetitions), and how many individual work periods (sets) were to be completed. The combination of repetitions and sets determined the amount or volume of work completed (Stone & O'Bryant, 1987).

Weight Training Experience - the amount of time an individual was involved in a weight training program.

Summary

Different modes of training serve specific purposes in building strength. Isometrics and dynamic lifting techniques used by themselves promote strength gains, but they have weaknesses. Isometric exercises do not build strength through the muscle's full range of motion, but only strengthened the muscle at specific joint angles.

Isometrics have limited range of motion which cause the lack of absolute strength gain for the entire muscle. Dynamic resistance exercises build strength for the entire muscle but the training effect is limited by the various stick points. When both training methods are used, the

stick point is reduced and strength is gained. These two types of training techniques help to strengthen the other lifting techniques weakness.

CHAPTER II

REVIEW OF RELATED LITERATURE

Introduction

This training study was derived from work done by O'Shea (1989) and Berger (1962) which involved the combination of isometrics and dynamic resistance exercises in a lifting program. The study conducted by O'Shea (1989) involved the squat exercise, and Berger (1962) used the touch and go bench press exercise. This chapter discusses isometric training, dynamic training, combined (dynamic/isometric) weight training exercises, and weight training protocols.

Isometric Weight Training

Isometrics only develop strength at the joint angles where these exercises were performed (Gardner, 1963; Logan, 1960). When an isometric contraction occurred the muscle used had tension placed on it but the muscle did not change in length. This type of weight training did not work the muscle through its entire range of motion, but would only strengthen the muscle at specific joint angles (Gardner, 1963). When performing isometrics the muscle being worked did not contract. In isometric exercises tension was produced on the muscles as the muscle pressed the bar

against the immovable object. Since the muscles being worked in isometrics did not move as observed in dynamic exercises, strength gains throughout the muscles range of motion were not observed (Chui, 1964).

Raitsin (1974) conducted a study which compared the effectiveness of strength training with isometrics and electro-stimulated methods at different joint angles of the elbow. Electro-stimulation of the muscle was done by a battery operated muscle stimulation device which had electrodes placed on the subject's body and these electrodes produced electric current in the body which was supposed to stimulate muscle growth.

There were eighteen subjects who participated in this study (Raitsin, 1974). These subjects had limited weight training experience and had never used this type of training. The joint angles that were trained were at 0° , 70° , and 150° . One-half of the subjects trained with isometrics and the other subjects used electro-stimulated training. This study lasted for 8 weeks and the subjects trained at these joint angles twice a week.

The results of the study demonstrated that both elbow joint angles were worked equally when isometrics were used. Strength training at large joint angles produced the most strength gain, while training at small joint angles produced less strength (Raitsin, 1974). Bilateral transfer of strength was equal at all joint angle positions and was not

dependent upon the size of the joint angle which was trained (Raitsin, 1974). Raitsin also stated that electro-stimulated training generated greater increase in strength compared to isometric training.

Through the use of isometrics, the joint angles worked were strengthened equally. Strength gained at specific joint angles was at 20 degrees flexion and extension of where the specific joint was worked. Bilateral strength of the joint angles was strengthened evenly at the specific joint angles.

Dynamic Resistance Weight Training

The use of free weight exercises or machines which allowed the muscle being worked to go through its entire range of motion exemplified a dynamic training exercise. Dynamic weight training built the entire muscle of a particular body part through eccentric and concentric muscle contractions (Olson, Schmidt, & Johnson, 1972). Eccentric contractions actually stretched the muscle which helped promote the muscle fibers to become stronger (Sterling, 1974). The stretched muscle fibers would build and strengthen the cross-sectional area of the muscle fiber. Concentric muscle contractions occurred when the muscle at work flexed and attempted to move the weighted object closer to the body.

Berger (1965) conducted a series of studies which involved the use of dynamic resistance training. Berger's

(1965), training study used resistance which was based on the subject's one repetition maximum (1-RM). He used nine groups of 20 men for a 12 week dynamic resistance training program. The subjects trained the bench press three times a week. The subjects were tested for a 1-RM at the start of the training cycle and at three intervals. The subjects were tested to see how much weight they could lift for 2RM, 6RM, and 10RM.

The results of the study demonstrated that all nine groups increased in strength (Berger, 1965). Training for three sets of an exercise per training session produced the best results compared to those who only used 2 or 1 set(s). Training with 6-RM was better for developing strength compared to 10-RM or 3-RM (repetitions) (Berger, 1965). The combination of training with 6-RM for three sets produced the most strength compared to any other training combination.

Berger (1965) concluded that training at submaximal loads twice a week and maximal once a week produced the same strength gain when subjects trained at near maximal all three times per week. The use of 3-RM to 9-RM repetitions were best to gain the most absolute strength. Training with 2-RM for 6 sets was as effective as training for 6-RM for 3 sets, 3 times a week. Training at 6-RM for 3 sets 3 times a week, produced more strength compared to training 2-RM and 10-RM for 3 sets 3 times a week.

Berger and Hardage (1967) conducted a study which used two groups of 25 male subjects using the bench press exercise. The training program lasted for 8 weeks and the training was based on the subject's 10-RM, after a 1-RM was taken prior to the training program. Group One trained with the same weight for the entire 8 week period, but training group Two had their 10-RM training cycle at maximum or near maximum effort during the 8 week training period. The results of this study stated that group Two demonstrated more gains in strength compared to group One. Weight training at or near maximal level of intensity would produce the most amount of strength (Berger & Hardage, 1967).

Through the use of dynamic resistance exercises, strength gains were observed after a few weeks of training, but this was mainly due to neurological factors. Since the muscle was worked through its entire range of motion, the cross sectional area of the muscle was increased and more strength was gained (Stone & O'Bryant, 1987).

Sale and MacDougall (1981) stated that sports specificity dynamic weight training exercises enhanced the strength of athletes compared to isometrics. Since most sport or physical activities were dynamic in nature, increased dynamic strength, speed, and power would be more beneficial to an athlete's performance.

Combinations of Dynamic and Isometric Lifting Programs

Functional isometrics and isometrics were similar in the way a lifter used them to train, but functional isometrics were task specific. The use of the strength curve which applied to weight machines was helpful to determine the stick points of dynamic lifts and where to apply isometrics. Plentnev (1975) and Ioseliani (1975) suggested that training the elbow flexors at 85 to 95 degrees of flexion would produce the best results. The use of functional isometrics was to gain increased strength at the weakest point of motion within the range of motion of a particular exercise. A term referred to as a strength curve was useful to the design of this study. This curve was used to describe the changes of the force arm and resistance arm as the muscles performed exercises on weight lifting machines (Kraemer & Fleck, 1987). The knowledge of the strength curve was helpful to determine the stick points of dynamic resistance exercises. The maximal amount of weight which could be lifted was determined by the amount of resistance that could be driven through the stick point in the movement (Kraemer & Fleck, 1987).

The use of functional isometrics with dynamic resistance exercises had been shown to cause significant increases in strength (Kraemer & Fleck, 1987). The reduction of stick points may increase the amount of weight

that could be lifted thereby increasing the overload on the muscle to cause increased strength gains.

Jackson et al. (1985) stated that the use of functional isometrics in conjunction with dynamic resistance training had been shown to help increase the 1-RM of dynamic lifts better than dynamic resistance exercises alone.

Kraemer and Fleck (1987) stated that this system of training was superior in cases where the goal of the lifting program was the increase the 1-RM capabilities of a particular lift.

Jackson et al. (1985) conducted a study which used functional isometrics in a dynamic lifting program, and used the touch and go bench press measurement as the strength test. There were two groups of male subjects ($N = 33$ experimental group, $N = 26$ control group) who volunteered to participate in the study. The training study lasted for 10 weeks and the subjects lifted three times a week. The subjects used 6-RM to 8-RM (repetitions) throughout the training period which was base upon a pretest 1-RM. The isometric training group performed six, six-second contractions per set for three sets, with 30-seconds rest between contractions. Isometrics were used three times per week and three joint angles were trained per training session. The dynamic lifting group trained between 6-RM to 8-RM, once the subject could lift a prescribed weight for 10-RM, the weight was increased until the subjects could

lift the weight between 6-RM and 8-RM. The lowest amount of repetitions used during this training program was 6-RM, based on work completed by Berger (1965). Both groups had the same training program except that one group used isometrics and one group did not. The results of the study indicated that the combined (isometric and dynamic) lifting group had a significant improvement in strength compared to the other lifting group.

In a study conducted by Berger (1962) functional isometric training in a dynamic strength training program for the touch and go bench press was used. Subjects trained for 10 weeks and lifted 3 times per week. There were 2 sets of 10 subjects per training group. The training program that the subjects used was based upon their pretraining cycle 1-RM. For the isometric portion, Berger had the subjects lift the bar 2 to 4 inches off their chest. The subjects pushed the bar against the immovable stop in the squat cage for 3 to 5 seconds. There were 5 seconds of rest between each repetition. During the isometric portion of the training program the subjects did 2 sets of isometrics per joint angle and 2 joint angles were used per training session. The subjects rested 3 minutes between sets of functional isometric contractions.

The weight used by the subjects was based upon their 1-RM which was taken before the 10 week training cycle started. The volume of training was the same for both

groups, and the exercises were similar except for one. Berger (1962) reported 20% strength gains and he noted that the intensity level of the subjects was more critical than the weight used during the isometric lifting sessions.

O'Shea (1989) conducted a study which used limited dynamic lifting techniques and isometrics for the squat exercise. Ten male subjects were used who were all experienced weight training athletes, but none of these subjects were exposed to isometric training. A 2 week conditioning period was used to build a training base, then a 6 week training cycle was conducted which combined isometrics and dynamic resistance exercises. After the 2 week conditioning period, a 1-RM was taken. During the training program the subjects used limited dynamic training techniques and functional isometrics. The subjects were paired according to their 1-RM results and were randomly assigned to a training group. One training group used only isometrics and the other training group used only dynamic lifting techniques. There were two training days per week which lasted for 1 hour. The first day (Tuesday) was the heavy training day and the second day (Friday) was a light lifting day. The isometric group trained at specific joint angles with weight to be used based on their 1-RM at the start of the 6 week cycle. The isometric group warmed up with 60 to 75% of their 1-RM prior to start of each isometric day they trained with isometrics. The subjects

who used isometrics trained at two joint angles per training session twice a week. The weight used ranged from 60 to 150% of the subjects 1-RM in the squat. The isometrics were performed for 2 sets of 3 repetitions and was held for 3 seconds. The dynamic training group performed only the squat exercise, and the weight used was based on their pretest 1-RM. As the weight to be lifted increased for both groups, the repetitions to be completed decreased.

The results of the study (O'Shea, 1989) showed that the use of functional isometrics combined with dynamic lifts increased the 1-RM strength of the squat. The combined training group (isometric and dynamic) showed a significant improvement in strength compared to the dynamic lifting group. The control group made improvements in strength, but not as much strength gain compared to the combined (isometric and dynamic) lifting group. The results (combined lifting group pretest 225 pounds, and posttest 325 pounds; dynamic lifting group pretest 278 pounds, and posttest 307 pounds) of the squat measurement test demonstrated that the combined lifting group made a significant ($p < .05$) improvement.

O'Shea (1989) also conducted a power test (vertical jump test) as another measurement tool for this study. When the results were observed (combined group improvement 3.40 inches, and dynamic lifting group 2.98 improvement inches)

the combined group gained more muscular power than the dynamic only group.

Weight Training Protocols

Studies by Chui (1964), Clarke and Henry (1961), Lhind (1979), and McIntosh (1974) found that isometric training increased the speed of contraction, while other studies (McIntosh, 1974; Tucker, 1957) observed that isometrics could retard speed of movement and power production. Kanehisa and Miyashita (1983) stated that isometric training at four different angles of the elbow flexor and a large number of training contractions must be used to promote maximum strength gain of the joint angle. Twenty, 6-second isometric contractions caused a greater carry over of strength to the joint angle compared to 6, 6-second contractions (Meyers, 1967).

Kraemer and Fleck (1987) stated that the tension exerted by a muscle in the performance of dynamic exercises was not constant but varied with the mechanical advantage of the joint during a dynamic muscle contraction. The tension which was exerted on the muscle was more intense for dynamic weight training exercises compared to isometrics. The overload produce on the muscle in dynamic exercises increased strength of the entire muscle compared to isometrics.

When performing functional isometrics in combination with dynamic exercises, Pekrofsky and Phillips (1986)

suggested that the weight to be lifted during isometrics should range from 50 to 100% of an individuals 1-RM in the lift. The weight was to be held for 5 seconds per contraction in each set.

Sterling (1974) stated that holding the bar at 95 degrees of flexion would produce the best results, and that functional isometrics were most effective in the development of muscular strength when they follow the form of dynamic exercises. Plentnev (1975) proposed that the greatest increase in strength occurred at 70 to 90 degrees of joint flexion, compared to 130 to 160 degrees of joint flexion.

A weight training program which combined isometrics with dynamic training might produce strength of both forms (O'Shea, 1989). Various studies on the combination of these two training principals were done (Berger, 1962; Jackson et al. 1985; & O'Shea, 1989) and found significant performance improvement when a combined lifting program was used.

Ioseliani (1975) conducted studies on how to properly train with isometrics in a combined training program. Ioseliani (1975) reported that functional isometric exercises could produce static effort at selective joint angles of dynamic resistance exercises. Ioseliani (1975) also suggested that maximum strength could be achieved if the tension in a muscle was performed at specific weak or stick points. The amount of weight used ranged from 70 to

90% of a 1-RM effort in a dynamic lift. An important characteristic of functional isometric training was that an individual could train a muscle group specifically and locally (Ioseliani, 1975).

Hettinger and Mueller (1953) stated that increased strength could be achieved by using as little as 35% of an individual's maximum force, although greater resistances produced better results. Berger (1962) reported that the use of 66% of an individual's 1-RM produced significant results in the squat exercise.

Gardner (1963), Meyers (1967), and Williams and Stutzman (1959) suggested that the joint angle specificity of a particular exercise had a carry over of plus and minus 20 degrees of joint angle being trained. Gardner (1963) also stated that isometric training of the elbow flexor at four different joint angles would increase strength in these joint angles and increased the dynamic power of the elbow flexor.

Summary

There were numerous methods of achieving strength and various types of lifting programs used to achieve this goal. Isometrics promoted strength gains at the point where they were applied (Lhind, 1979). Dynamic weight lifting exercises produced the most strength gains, but stick points limited the use of maximum weight and muscle growth (Kraemer & Fleck, 1987).

The combination of dynamic resistance exercises and isometrics produced better results using combined training programs (Berger, 1962; Jackson et al. 1985; O'shea, 1989) as compared to dynamics or isometrics only. Past research had demonstrated (Berger, 1962; O'Shea, 1989) that there was a 20% increase in the overall strength and improved muscular power when both dynamic exercises and isometrics were combined. Various joint angles must be trained to decrease the stick points of dynamic exercises. Weight training would always produce an effect which would be stronger muscles, but proper training balance, combined isometrics with dynamics, would produce a better result.

The TG bench press and the DS press tests both measure the strength of the upper body (see Appendix A). The traditional TG bench press was used (Berger, 1962) in other studies as a measurement of strength, but it was felt that the DS and press measurement was more sensitive to stick points and would show a more accurate picture of the subjects strength. The DS and press measurement had the lifter press the bar off a set of pins at chest level, the start point of this test was where a stick point was at for a majority of lifters.

Unlike previous studies, this weight training program was a functional weight training study which could be used by various individuals who wanted to improve their strength. This study was more ecological than others (Berger, 1962;

O'Shea, 1989) in that it was not a pure training study which used only the core lift which the researchers used as their measurements for increased strength.

For this study, the isometric work done by the experimental (combined training group) group would be done twice a week, and two joint angles would be trained per training session for 5 repetitions per set. The weight to be lifted for the isometrics and dynamic lifting program was based on their pretest 1-RM. The weight for the isometric portion would be held for 5 seconds, and 2 to 5 minutes rest between sets was given. As the weight to be lifted increased, the sets and repetitions decreased. The training program for both groups was the same except for the one training exercise (isometrics) which was the independent variable for the training study.

CHAPTER III

METHODS AND PROCEDURES

Introduction

This training study was derived from work done by O'Shea (1989) and Berger (1962). These investigations involved the combination of isometrics and dynamic resistance exercises in a lifting program. This training study investigated the effects of dynamic resistance training compared to combined (dynamic and resistance) training to observe if strength was improved. Previous studies (Berger, 1962; and O'Shea, 1989) reported greater improvement in strength and muscular power for the combined group compared to the dynamic only group.

This study used a practical training routine along with isometrics, and by including the dead stop (DS) bench press a more accurate picture of the subjects strength would be observed. The DS and press measurement test was used because it was more sensitive to stick points as opposed to the touch and go (TG) bench press test. It was felt that the DS would be more sensitive to stick points. The study was designed so that the subjects would train their whole upper body to improve their strength in the two bench press tests, and not just train the bench press by itself.

Subjects

Twenty-four healthy subjects participated in this study. The subjects were lifters with at least three months of weight training experience prior to the time they agreed to participate in the study. The demographic variables of the 24 male subjects are presented in Table 1 (see Appendix B).

Table 1. Demographic variables of the subjects who participated in this study (N = 24)

Variable	Mean	Standard Deviation	Range
Age (yrs)	20	2.8	12
Height (inches)	68	1.72	7
Weight (pounds)	179	27.5	115

Weight Training Orientation

There were 24 healthy college students who volunteered to participate in this study (Mean age = 20 years $\pm$ 2.7 years). The use of subjects for this study was approved by the Human Subjects Committee at the University of Wisconsin-La Crosse.

This researcher met with the subjects at the Mitchell Hall Strength Center on Wednesday January 25, and Thursday January 26, 1995. At this meeting the investigator explained to the subjects the purpose of the study and

potential risks. The subjects who were interested in the study signed an informed consent (see Appendix C), and were given an outline of the training program. The subjects were given the instructions of how to properly perform the tests (see Appendix A), the dates of the pretest and posttest, as well as the pretest instructions (see Appendix D).

An official meeting was set up for the week of January 29, 1995 during the subjects' weight training class. The subjects were instructed on how to properly use the weight training equipment involved in the study. The two types of 1-RM bench press tests were demonstrated to the subjects (see Appendix A).

During the next weight training class, the subjects performed the two bench press tests and determined a 1-RM for each exercise. The two groups of subjects were not balanced according to their pretest scores in the two bench press measurements. Due to limited time and use of exercise equipment, this researcher designated one of the physical education classes as the dynamic lifting group (DO) and the other class as the combined (dynamic and isometric) lifting group (CG).

On the following week of February 5, 1995, the subjects started their 10 week training program. The subjects received their proper 10 week workout each time they came to class. Any questions that the subjects had were answered. The DO training group used only dynamic resistance exercises

(see Appendix E), and the other group (CG) used dynamic exercises with isometrics (see Appendix F). After the 10 week lifting cycle was completed a posttest was given. The pre- and posttest bench press tests were conducted in the same fashion.

Equipment

F-Scan Sensor

The purpose for using the sensor was to make sure the subject's exerted the same level of force for all training sessions. The F-Scan sensor was originally designed to measure the pressure by the foot when it made contact with the ground (see Appendix G). For this study, the sensor was wrapped around the loaded bar when the isometric weight training took place. The sensor monitored the subjects to make sure they exerted the same level of intensity for all training sessions and establish consistency of the subject's intensity.

Power Rack

A power rack (see Figure 1) was used for the dead stop bench press max test and isometric work. This rack was 4 feet wide and 5 feet long. There were four metal pillars which made up the rack. Two of these pillars were on the left side and two pillars were on the right side. In each pillar there were holes for the pins to go through, and the barbell was placed on the pins which were in the holes of the pillars. Each side of the power rack had two sets of

pins and the bar was placed on the lower level of the pins. The weighted bar was then pushed from the lower level of pins through the top pins. A flat bench was used for the subjects to lay down on when they performed isometric work.

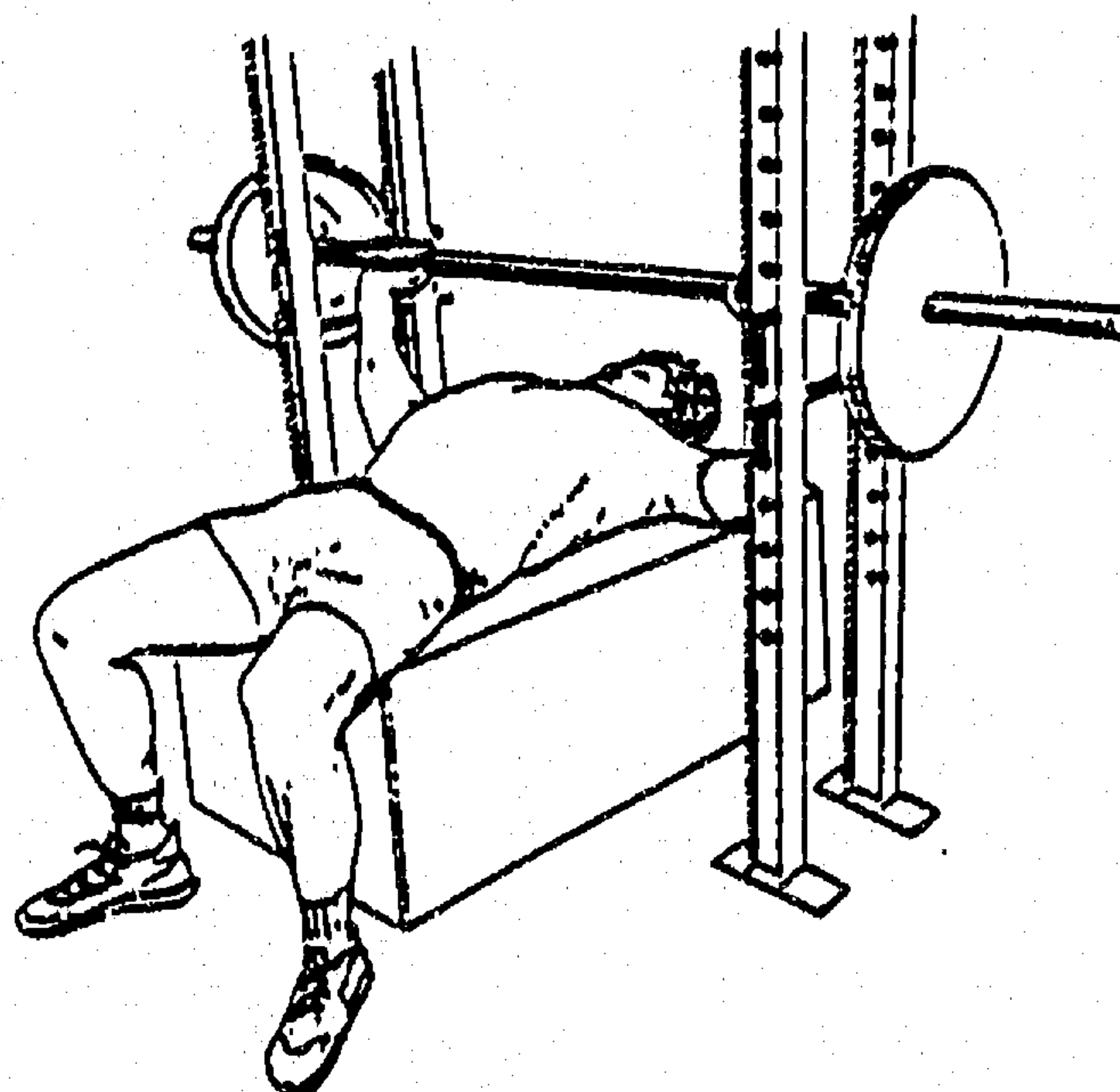


Figure 1. PICTURE OF A POWER RACK

The rest of the exercise used in this training program was the shoulder press, latissimus dorsi pull-downs, biceps curls, triceps extensions, triceps pushdowns, forward and lateral raises, and seated rows (see Appendices D and E).

Training Methods

An important training concept called periodization was developed to work on specific goals which reduced weak points of particular lifts (see Table 2) (Stone, O'Bryant,

Garhammer, McMillian, & Rozenek, 1992) and (Stone, O'Bryant, & Garhammer, 1987). This researcher used this training principle in his 10 week study. The core lift that was trained during this time was the bench press exercise. Three meso-cycles which make up one full 10 week training macro-cycle was used in the particular training program. The weight lifted by the subjects was based on the 1-RM on their bench press when the subjects took their pretest (see Appendix H).

Table 2. Theoretical model of strength (associated with Matveyev's periodization model)

	Preparation	Transition	Competition	Transition 2	
Phase	Hypertrophy	Basic Strength	Strength and power	Peaking or maintenance	Active Rest
Sets	3-10	3-5	3-5	1-3	N O L I F T I G
Reps	8-12	4-6	2-3	1-3	
Days/wk	3-4	3-5	3-5	1	
Intensity of workout	low	high	high	very high	
Volume of work	high	moderate to high	low	very low	

Note * From Stone & O'Bryant, 1987.

A term referred to as a strength curve was useful to the design of this study. The curve was used to describe the change of the force and resistance arms. By analyzing the strength curve it was clear that the joint angles of 85

to 95 degrees of flexion must be worked the most, where the stick point was the greatest.

Following an introduction to the weight lifting equipment, subjects were assigned to either the DO or CG group. The subjects were instructed on how to properly use the equipment and informed of any dangers that might occur if the equipment was improperly used. Both groups trained heavy the first day of class and light on the second day of their weight training class. The subjects were enrolled in a physical education weight training class and the training sessions lasted 45 minutes. The training loads in terms of volume of work and intensity were the same. The only difference in training was the isometric work of the CG was replaced by supine dumbbell bench presses in the DO weight lifting group. The group that used isometrics and dynamic lifts trained isometrics at two different joint angles each week (see Appendix I).

The amount of weight lifted gradually increased as the weeks of the training cycle progresses. Each training session was conducted as follows: 1) warm up and light stretch; 2) work out; 3) stretch and cool down. The subjects were given the option to ride the exercise bike as a warm up and cool down activity. The type of training which was done by the subjects in the study was more practical, and similar to weight training programs done by individuals who were not in a training study but working out

by themselves. The only difference was that isometrics were used in this training program which reduced stick points of the bench press exercise to help increase the subjects strength and 1-RM.

Once the 10 week training cycle was completed the subjects took a posttest (see Appendix A). The posttest was exactly like the pretest and the subjects were to follow the pretest instructions. Before the tests were administered the subjects were to properly warm up and be reminded of the possible disqualifications during the 1-RM bench press tests (see Appendix A).

Statistical Analysis

A 1-RM for both the TG and the DS bench press measurement tests from 24 subjects were analyzed by multivariate analysis with the SAS (Statistical Analysis Systems) program. It was used to find if the CG training program improved the 1-RM of the two bench press tests (touch and go bench press bench press) of the subjects who used this program, compared to the DO subjects. If the null hypothesis was rejected in the MANOVA model, then a univariate ANOVA would be conducted on the two different measurements to determine which variable contributed to the overall difference.

For this study the isometric work to be done by the combined lifting group would be done twice a week, and 2 joint angles would be trained for 5 repetitions per set.

Each repetition would be held for 5 seconds, and 2 to 5 minutes rest between sets was given. The weight lifted for both the isometric and dynamic lifting was based upon a pretest 1-RM. As the weight got heavier to lift, the repetitions and sets decreased (see Appendices E, F, H, and I).

CHAPTER IV

RESULTS AND DISCUSSION

Introduction

The purpose of this study was to determine if the subjects who lifted with a combined (dynamic and isometric) training program would perform better in two bench press measurement tests than subjects who trained with only dynamic resistance exercises. A total of 24 subjects, ages 18 to 30 volunteered to participate in the study. Twelve subjects were assigned to the dynamic only group (DO) and 12 to the combined group (CG).

The measurement tests used in this study were the touch and go (TG) and dead stop (DS) bench press tests. This chapter presented the results of the statistical treatment of the data as well as a discussion of the results.

Results

There were 24 male subjects who volunteered to participate (see Table 3). All of the subjects had at least 3 months of weight training experience prior to the start of this study. The mean age of the subjects was 20 years of age. The mean height of the subjects was 68 ± 1.72 inches. The average weight of the subjects in both groups was 178.75 ± 27.55 pounds.

Table 3. Descriptive characteristics of the subjects who participated in this study (N = 24)

Variable	Mean	Standard Deviation	Range
Age (yrs)	20	2.80	12
Height (inches)	68	1.72	7
Weight (pounds)	179	27.50	115

Bench Press Measurement Procedures

The subjects in the experimental CG and control DO took a pretest measurement in the TG and DS. After the pretest the 24 subjects were placed in one of two groups, the DO or CG. The volume of work done in each workout was similar and both groups had similar workouts except for one exception, the CG group used isometrics while the DO group used supine dumbbell bench presses.

The pretests between the two groups of subjects were statistically tested (see Table 4) to see if there were any initial differences. There was no statistical difference observed. The TG (Combined group and Dynamic $T = 0.3456$ and $P = 0.733$) results demonstrated no significance and the DS (Combined group and Dynamic group $T = 0.0220$ and $P = .984$) did the same. The improvements observed in the posttest bench press measurements were due to the training techniques used by the subjects in their respective training programs.

Table 4. Initial pretest measurement for both training groups (N = 24)

Group	Bench press			Dead Stop		
	X	±	SD	X	±	SD
Experiment	200.43	±	63.48 (NS)	174.65	±	49.65 (NS)
Control	192.10	±	53.70	174.16	±	52.25
	T = 0.3456			T = 0.0200		
	P-value = 0.7330			P-value = 0.9840		

NS = No significant differences

After comparison of the results of the DS and TG, it was apparent that the CG lifting group made more strength gains compared to the DO lifting group (see Table 5). The CG group had a pretest TG average score of 200.43 pounds and a posttest score of 231.25 pounds. This was an average improvement of 30.90 pounds for the TG. Conversely, the DO group had a pretest average score of 192.10 pounds and a posttest score of 202.92 pounds. This was an average improvement of 12.50 pounds.

When the DS 1-RM scores were observed, it was also apparent that the CG lifting group produced the most strength gains (see Table 5). The CG group had a pretest DS average score of 174.65 pounds and a posttest score of 202.92 pounds. The improvement in the DS for the CG lifting group was 28.40 pounds. On the other hand, the DO lifting group had a DS pretest score of 174.16 pounds and a posttest score of 180.83. The improvement in the DS for the DO lifting group was 6.67 pounds.

Table 5. The means and standard deviations of the two bench press measurements in the two groups

Lifting Group	Pretest X $\pm$ SD	Posttest X $\pm$ SD	Pre - Post X $\pm$ SD
Experiment Group	¹ 200.43 $\pm$ 63.48 ² 174.65 $\pm$ 49.65	231.25 $\pm$ 58.23 202.92 $\pm$ 51.37	30.90 $\pm$ 9.50 28.40 $\pm$ 10.73
Control Group	¹ 192.10 $\pm$ 53.70 ² 174.16 $\pm$ 52.25	204.58 $\pm$ 52.46 180.83 $\pm$ 48.80	12.50 $\pm$ 9.42 6.67 $\pm$ 11.55

¹ = Bench press measurement
² = Dead stop measurement

Comparison of Overall Group Effect on Measurement Tests

A MANOVA was used to determine if there was significant differences between the two training groups on the posttest mean scores of the two bench press measurements (see Appendix J). Analysis of the mean difference of the TG and DS measurement data using a Holling's T^2 (see Table 6) indicated that the CG experimental group demonstrated improvement at the .05 level of significance.

A multivariate test (see Table 6) ($F = 16.8654$ and $P = 0.0001$) between the two groups demonstrated a significant difference between the two groups and showed that the combined group lifted more weight in the measurement tests compared to the dynamic only group. The univariate test for the TG ($F = 22.56$ and $P = 0.0001$) also demonstrated a statistical difference in strength for the combined lifting group and the combined lifting group lifted more weight. A univariate test (F -value = 23.02 and P -value = 0.0001)

for the DS measurement was conducted and significance was found. This result showed that the combined lifting group increased in greater strength compared to the dynamic group.

Since the Holling's T^2 test was significant two post hoc tests were (see Table 5) conducted on the TG and DS measurement test. The null hypothesis was rejected for the multivariate test and a univariate test must be conducted to observe the differences of the TG and DS between the groups.

Table 6. Multivariate and univariate output for comparison of the two groups of subjects

	Multivariate	Univariate	
	(TG)	Bench Press	Dead Stop Bench Press
F-Value	16.8654	22.56	23.02
P-Value	.0001 #	.0001 *	.0001 *

Indicates a Significant Difference between groups (p < .05) using two measurement groups.

* Indicates a Significant Difference from Pretest (p < .05) using two measurement groups.

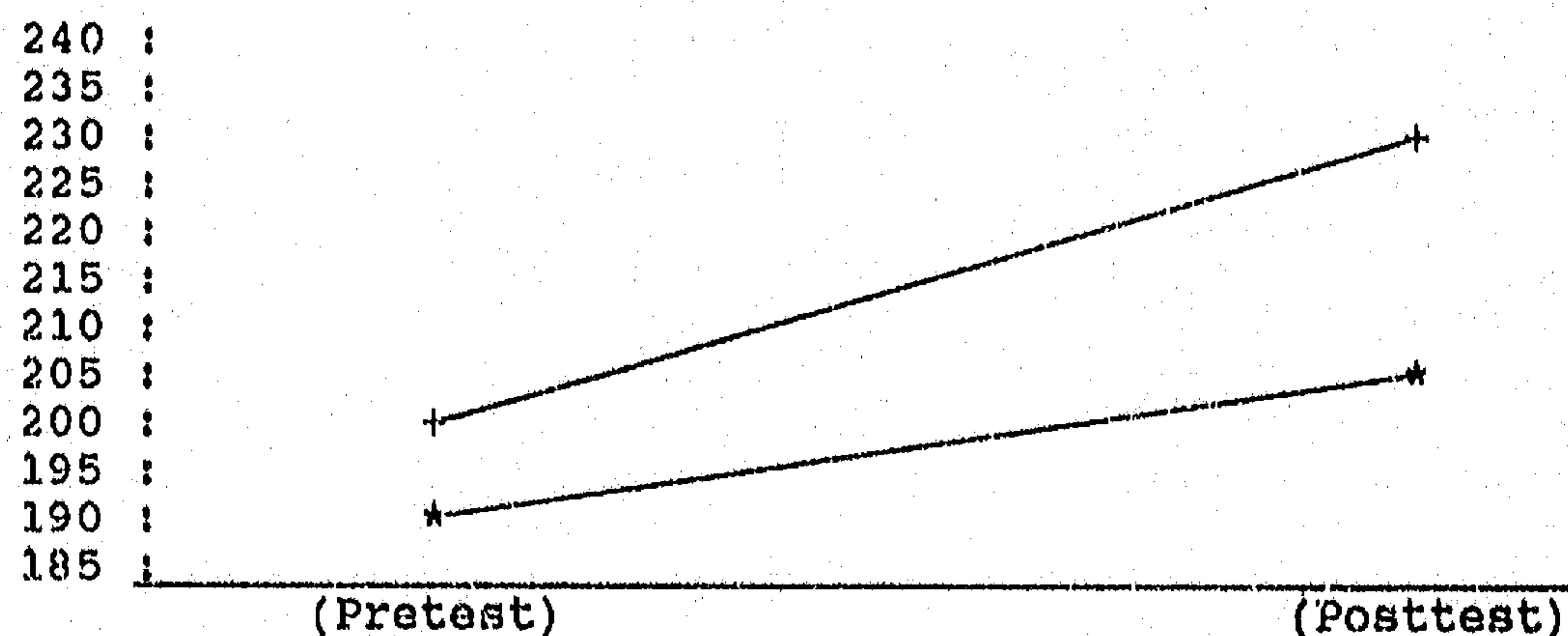
Discussion

After analysis of the data from the comparisons of the two tests (see Figure 2) it was evident that the experimental CG group demonstrated significant strength gains compared to the DO control group. The DO lifting group made some strength gains at the end of the 10 week

training cycle, but not as much improvement as the CG lifting group.

When the TG measurement results (see Figure 2) were observed, the CG group improved their TG an average of 30.90 pounds per subject. This group had a mean score of 200.42 pounds for their pretest and ended with a mean score of 231.25 pounds on the posttest. The control group DO improved their TG an average of 12.50 pounds per subject. This group had a mean score of 192.10 pounds for their pretest and ended with a mean score of 204.56 pounds on the posttest. The experimental group improved 18.40 pounds per subject more in TG compared to the control group.

Pounds lifted



(* = Dynamic Only group) (+ = Combined lifting Group)

Figure 2. Comparison measurement test results between the groups for the TG bench press test

The CG group improved their DS an average of 28.40 pounds per subject (see Figure 3). This group had a mean

score of 174.65 pounds for their pretest and ended up with a mean score of 202.92 pounds in the posttest. The control group improved their DS an average 6.67 pounds per subject. This group had a mean score of 174.25 pounds on the pretest and ended up with 180.83 pounds on the posttest. The experimental group improved 21.73 pounds per subject more on the DS compared to the control group.

Pounds Lifted

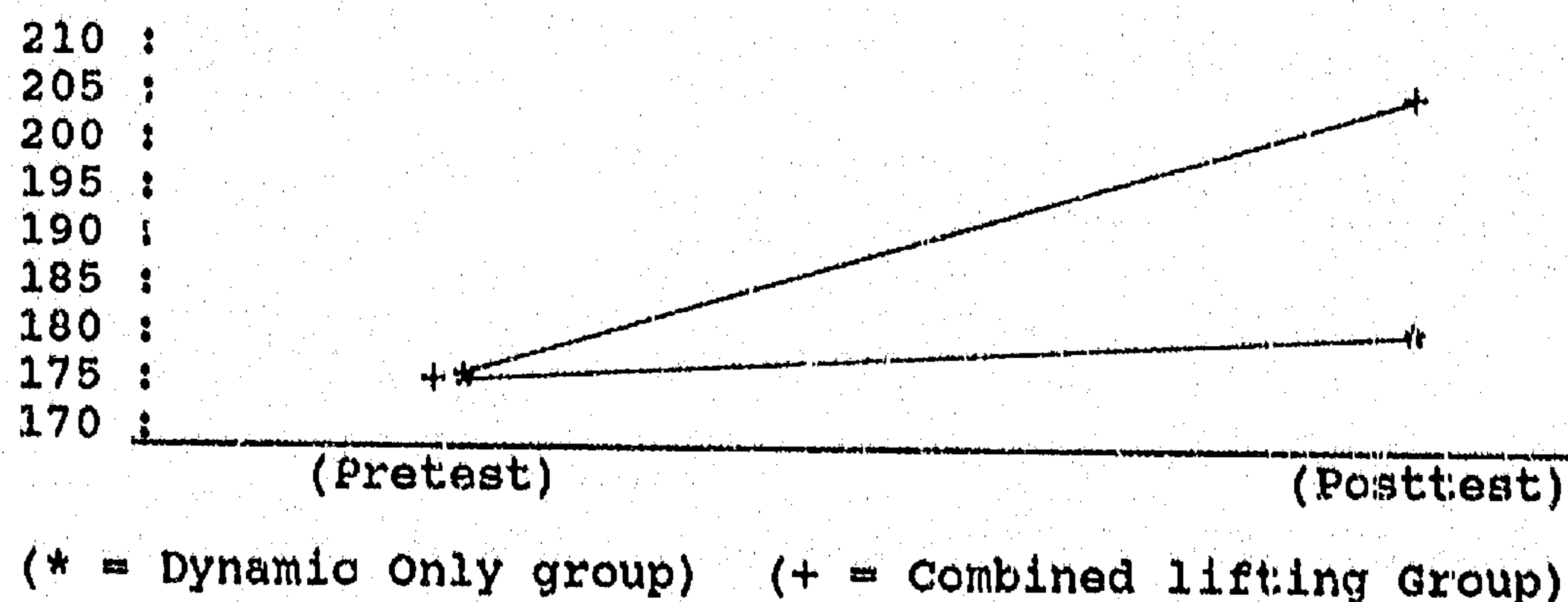


Figure 3. Comparison of measurement test results between the groups for the dead stop and press test.

The use of isometrics helped build strength at the specific joint angles where this type of training was applied, thus reducing the effect of a stick point. Dynamic resistance training built strength for the entire muscle, but the stick points which occur in these exercises limited the amount of weight that could be used with this type of lifting technique. The combination of isometrics and

dynamic lifting exercises helped to build strength for the entire muscle group and reduced the stick points of the dynamic exercises.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The purpose of this study was to determine if the subjects who lifted with a CG training program would lift more weight in the two bench press measurement tests when compared to the subjects who only trained with DO exercises. Twenty-four subjects volunteered to participate in the study, ages 18 to 30.

The two measurement tests used in this study were the free weight TG and DS measurement tests. After the pretest was finished both groups of subjects completed a 10 week training program. The type of training for both groups was similar except for one training exercise. The experiment group used functional isometrics CG and the control group DO used bench press dumbbell press. After the 10 week training cycle was completed, a posttest was conducted.

Pre- and posttest data were collected and analyzed from the control and experimental groups to determine if a significant change occurred in response to the weight training programs. The results from this study indicated that the experimental group had a significant increase in strength for both TG and DS measurement tests.

Conclusions

Based on the statistical analyses of the data the following conclusions were reached.

1. The combined lifting group outperformed the dynamic lifting group on the touch and go (TG) bench test.
2. The combined lifting group outperformed the dynamic lifting group on the dead stop (DS) and press measurement test.
3. Dynamics and isometrics should be combined in a weight training program to build strength of a particular muscle and then reduce stick points of dynamic lifts which strengthen the muscle.

From the comparison of the data it seemed apparent that the experimental group benefited by the use of isometrics in a training program. It seemed to help them improve strength in both bench press measurements (18.40 pounds improved in TG; and 21.73 pounds improved in the DS). The DS measurement which had a similar start point as a functional isometric contraction seemed to be most effected by the use of isometrics.

The use of isometrics to build strength of an entire muscle group produced little overall benefit to the lifter. Isometrics were found to be an ineffective way build strength throughout the muscles full range of motion. When isometrics were used it would strengthen a particular joint

angle, and strengthened the joint at 20 degrees flexion and extension.

Dynamic resistant exercise was shown to have a positive effect on building strength of a muscle group. Dynamic exercises worked the muscle through the joints entire range of motion. The problem with dynamic resistance exercise was that the stick points of these exercises limited the amount of weight an individual could lift.

Through the combination of functional isometrics and dynamic resistance weight training exercises, more strength was developed in the CG than when DO or isometrics were only used to build strength. Individuals would increase their strength and muscle through use of dynamic resistance exercise. The use of functional isometrics at particular joint angles of a core lift (bench press) would help reduce the effect of stick points of the bench press exercise. The combination of these two training principles helped make the strength athlete functionally stronger by reducing the strength loss due to the stick points of the free weight exercise.

Recommendations for Future Research

Based upon the results of this particular study, the following recommendations for future research were made.

1. A similar study should be conducted using a larger sample size, then a generalized statement could be made about the effectiveness of a combined lifting program.

2. A similar investigation should be performed using the same subjects but the subjects should be in opposite groups. This would retest the procedures of the study to see if the same results would occur.
3. A similar type of study should be conducted, but the subjects should lift three times a week which would have them spend more time training the bench press.
4. A similar investigation should be performed, but the training cycle could be reduced or increased in length. This would see if the length of the training cycle would influence the amount of strength gained.
5. A similar type of study should be conducted with the same training principles for different lifts. This would be to observe if the same training principles would apply for different dynamic lifts.
6. All of the five previous recommendations for future research should be conducted with the use of female subjects.

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APPENDIX A
BENCH PRESS TESTS PROTOCOLS

Protocol for Bench Press Max tests

1. The subject gets two tries to lift a particular weight.
2. Subjects could increase the weight they lift as long as the weight could be pressed up with good lifting form (according to the bench press protocol).
3. Once the subject failed to press the weight up on their second attempt, the test was completed.

A. Touch and Go bench press test.

1. Once the subject was in proper position to receive the bar (see proper execution of the bench press exercise), the subject would say ready.
2. The subject could either lift the bar off of the bench press stand or have it handed to them.
3. At this point the subject would lower the bar in a controlled manner to their chest, and hold the bar at chest level for one second and then press the bar.
4. Then subject would rack the bar on the bench press stand and the lift would be over.

B. Dead Stop bench press test.

1. When taking this test the subject would be inside a squat cage with the pins in the cage at chest level.
2. The weighted bar to be lifted would be placed on the pins in the squat cage.
3. The subject would indicate when ready to do the test and proceed to press the bar upward until the subjects arms were completely extended.

Disqualifications for both tests

1. Bar bounced on chest.
2. Failure to completely press the bar upward and extend the arms.
3. Any assistance by spotter during the test.

INSTRUCTIONS FOR PROPER EXECUTION OF THE BENCH PRESS EXERCISE

The bench press is a dynamic exercise which was done by having the lifter lie down on a flat bench in a supine position with his/her feet planted on the floor. The hand placement should be such that the lifter's elbows are at a 90 degree joint angle position. Once the body of the lifter was in proper position the bar is to be lifted off the rack or support jacks. The elbow flexors were to be completely extended prior to the execution of the lift. Once this was accomplished the lifter would inhale and slowly bring the bar down to his/her chest. Once the bar touches the chest, the lifter would pause for a second and press the bar upward while exhaling until the elbows were completely extended. Each lowering and pushing the weighted bar off the chest equalled one repetition. Once the lifter had finished the prescribed number of repetitions the bar was placed back on the rack. When the bench press exercise was performed the head, trunk, and lower extremities of the subject could not move or the repetition would not count.

APPENDIX B

RAW DATA ON SUBJECTS' PHYSICAL CHARACTERISTICS

Characteristics of subjects

Subject	Age yrs	Weight pounds	Height inches
01	18	105.00	66
02	18	115.00	68
03	19	220.00	68
04	19	195.00	70
05	19	190.00	66
06	19	195.00	69
07	19	185.00	66
08	19	185.00	66
09	19	175.00	70
10	19	170.00	69
11	19	180.00	67
12	19	210.00	67
13	20	195.00	68
14	20	190.00	68
15	20	195.00	70
16	20	145.00	66
17	20	190.00	72
18	20	180.00	69
19	20	180.00	68
20	22	195.00	68
21	22	215.00	71
22	23	180.00	67
23	27	145.00	68
24	30	155.00	65
Mean	20 yrs.	178.75 lbs	68"
S.D.	2.74	27.55	1.72

APPENDIX C
INFORMED CONSENT

Informed Consent

For Dynamic and Isometric Weight Training, and Dynamic
Training Only Weight Training Study

I _____, at _____ years of age do here by consent to participate in the dynamic and isometric training program. I understand that participation in this study requires that I must complete two different types of 1 RM max tests for bench press.

There will be a training session describing the lifts that I am to perform. When I am able to demonstrate proper form using all the different exercises that will be in the program, I can participate in the study.

The first test that I must perform involves a touch and go 1 RM bench press max. There will be no bouncing the bar off of the chest or cheating when performing this test. The other test involves a 1 RM bench press max test where the bar will be resting on the chest at the start, and all I have to do is press the bar in an upward position. The bar will be placed on pins in a squat rack during this second test (dead stop bench press test).

I state that to the best of my knowledge that I am in good physical and mental health. I have no physical condition that would in any way limit my participation in this study which could cause potential injury.

I understand that there will be potential risks involved during this study. If any type of injury or abnormal situation occurred, the test will be stopped. At the same time there will be potential benefits of strength gains and information on how I can become stronger.

I have read the above document and have been fully advised of what responsibilities I must do if I agree to participate in this study. Any questions that I had were answered by the researcher to my satisfaction. I here by volunteer my time and efforts to participate in this study.

Signed at _____, this _____ day of _____, 19____ in the presence of the witnesses whose signature appears opposite my signature.

Witnessed by

Subject signature _____ Date _____

Signature _____ Date _____

Signature _____ Date _____

Procedures to follow at meeting with subjects
Before the subjects signed the Informed Consent

- A. Explained the training cycle and tests.
 - 1. One week prior to pretest gather all subjects and make sure they knew how to use the equipment properly and what the max tests were.
 - 2. Test one (touch and go bench press) traditional bench press exercise.
Test two (Dead stop bench press) start at bottom part of lift with bar resting on chest inside a squat rack (the bar must not move), and then press the bar up.
 - 3. Tell time(s) and date(s) for pretest, posttest and training schedule.

- B. Potential risks or discomforts
 - 1. Aching muscles - Muscle soreness
 - 2. Rise in blood pressure - Isometric exercises
 - 3. Bodily injury - improper usage of exercise equipment

- C. Benefits
 - 1. Strength gains
 - 2. Knowledge of isometrics
 - 3. How to use dynamic and isometric lifts together in a Training program
 - 4. Prevent injuries

- D. Responsibilities of the subjects who were participating in the study
 - 1. Show up to and be on time to lift
 - 2. Follow weight lifting program
 - 3. Be motivated to workout
 - 4. Follow the pretest instructions

APPENDIX D
PRETEST INSTRUCTIONS

Please follow these instructions given to you to prevent any possible extraneous factors which could effect these tests.

1. Do not consume any drugs of any kind 24 hours prior to testing.
2. Do not exercise 24 hours prior to taking these bench press tests.
3. Refrain from strenuous activity 48 to 72 hours before participating in this test.
4. Get a good night sleep and be motivated to do your best.
5. Wear comfortable clothing to the test.

APPENDIX E
DYNAMIC WEIGHT LIFTING PROGRAM

NAME: _____

DATE: _____

WEEK: 1

WARM UP:

1. RIDE BIKE
2. STRETCH 5 MINUTES

DAY: 1

BENCH PRESS	* 8 * 2
DUMBBELL PRESS	2 * 10
SHOULDER PRESS	3 * 10
LAT. PULLDOWN	3 * 8
TRICEP EXTENSION	3 * 8
HAMMER CURL	3 * 8

DAY: 2

BENCH PRESS	* 8 * 2
DUMBBELL PRESS	2 * 10
FORWARD RAISE	2 * 10
LATERAL RAISE	2 * 10
SEATED ROWS	2 * 8
TRICEP PUSHDOWN	3 * 8
BAR-BELL CURLS	3 * 8

COOL DOWN:

1. STRETCH: 5 MINUTES

NAME: _____

DATE: _____

WEEK: 2

WARM UP:

1. RIDE BIKE
2. STRETCH 5 MINUTES

DAY: 1

BENCH PRESS	* 8 * 2
DUMBBELL PRESS	2 * 10
SHOULDER PRESS	3 * 8
LAT. PULLDOWN	3 * 8
TRICEP EXTENSION	3 * 8
HAMMER CURL	3 * 8

DAY: 2

BENCH PRESS	* 8 * 2
DUMBBELL PRESS	2 * 10
FORWARD RAISE	2 * 10
LATERAL RAISE	2 * 10
SEATED ROWS	2 * 8
TRICEP PUSHDOWN	3 * 8
BAR-BELL CURLS	3 * 8

COOL DOWN:

1. STRETCH: 5 MINUTES

NAME: _____

DATE: _____

WEEK: 3

WARM UP:

1. RIDE BIKE
2. STRETCH 5 MINUTES

DAY: 1

BENCH PRESS	* 5 * 2
DUMBBELL PRESS	2 * 10
SHOULDER PRESS	3 * 8
LAT. PULLDOWN	3 * 8
TRICEP EXTENSION	3 * 8
HAMMER CURLS	3 * 8

DAY: 2

BENCH PRESS	* 8 * 2
DUMBBELL PRESS	2 * 10
FORWARD RAISE	2 * 10
LATERAL RAISE	2 * 10
SEATED ROWS	2 * 8
TRICEP PUSHDOWN	3 * 8
BAR-BELL CURLS	3 * 8

COOL DOWN:

1. STRETCH: 5 MINUTES

NAME: _____

DATE: _____

WEEK: 4

WARM UP:

1. BIKE RIDE
2. STRETCH 5 MINUTES

DAY: 1

BENCH PRESS	* 5 *	2
DUMBBELL PRESS	2 *	10
SHOULDER PRESS	3 *	8
LAT. PULLDOWN	3 *	8
TRICEP EXTENSION	3 *	6
HAMMER CURL	3 *	6

DAY: 2

BENCH PRESS	* 8 *	2
DUMBBELL PRESS	2 *	10
FORWARD RAISE	2 *	10
LATERAL RAISE	2 *	10
SEATED ROWS	2 *	8
TRICEP PUSHDOWN	3 *	6
BAR-BELL CURLS	3 *	8

COOL DOWN:

1. STRETCH: 5 MINUTES

NAME: _____

DATE: _____

WEEK: 5

WARM UP:

1. RIDE BIKE
2. STRETCH 5 MINUTES

DAY: 1

BENCH PRESS	* 8 *	2
DUMBBELL PRESS	2 *	10
SHOULDER PRESS	3 *	6-8
LAT. PULLDOWN	3 *	6-8
TRICEP EXTENSION	3 *	6
HAMMER CURLS	3 *	6

DAY: 2

BENCH PRESS	* 8 *	2
DUMBBELL PRESS	2 *	10
FORWARD RAISE	2 *	10
LATERAL RAISE	2 *	10
SEATED ROW	2 *	8
TRICEP PUSHDOWN	3 *	6
BAR-BELL CURLS	3 *	6

COOL DOWN:

1. STRETCH: 5 MINUTES

NAME: _____

DATE: _____

WEEK: 6

WARM UP:

1. BIKE RIDE
2. STRETCH 5 MINUTES

DAY: 1

BENCH PRESS	* 8 *	2
DUMBBELL PRESS	2 *	10
SHOULDER PRESS	3 *	6
LAT. PULLDOWN	3 *	6-8
TRICEP EXTENSION	3 *	6
HAMMMER CURLS	3 *	6

DAY: 1

BENCH PRESS	* 8 *	2
DUMBBELL PRESS	2 *	10
FORWARD RAISE	2 *	10
LATERAL RAISE	2 *	10
SEATED ROWS	2 *	8
TRICEP PUSHDOWN	3 *	6
BAR-BELL CURLS	3 *	6

COOL DOWN:

1. STRETCH: 5 MINUTES

NAME: _____

DATE: _____

WEEK: 7

WARM UP:

1. BIKE RIDE
2. STRETCH 5 MINUTES

DAY: 1

BENCH PRESS	* 5 *	2
DUMBBELL PRESS	2 *	8
SHOULDER PRESS	3 *	6
LAT. PULLDOWN	3 *	6-8
TRICEP EXTENSION	3 *	4-6
HAMMER CURL	3 *	4-6

DAY: 1

BENCH PRESS	* 5 *	2
DUMBBELL PRESS	2 *	8
FORWARD RAISE	2 *	10
LATERAL RAISE	2 *	10
SEATED ROWS	2 *	8
TRICEP PUSHDOWN	3 *	6
BAR-BELL CURLS	3 *	6

COOL DOWN:

1. STRETCH: 5 MINUTES

NAME: _____

DATE: _____

WEEK: 8

WARM UP:

1. BIKE RIDE
2. STRETCH 5 MINUTES

DAY: 1

BENCH PRESS	* 5 * 2
DUMBBELL PRESS	2 * 6-8
SHOULDER PRESS	3 * 5
LAT. PULLDOWN	3 * 6
TRICEP EXTENSION	3 * 5
HAMMER CURL	3 * 5

DAY: 2

BENCH PRESS	* 5 * 2
DUMBBELL PRESS	2 * 6-8
FORWARD RAISE	2 * 10
LATERAL RAISE	2 * 10
SEATED ROWS	2 * 8
TRICEP PUSHDOWN	3 * 6
BAR-BELL CURLS	3 * 6

COOL DOWN:

1. STRETCH: 5 MINUTES

NAME: _____

DATE: _____

WEEK 9

WARM UP:

1. BIKE RIDE
2. STRETCH: 5 MINUTES

DAY: 1

BENCH PRESS	* 3 * 2
DUMBBELL PRESS	2 * 5
SHOULDER PRESS	3 * 5
LAT. PULLDOWN	3 * 6
TRICEP EXTENSION	3 * 5
HAMMER CURLS	3 * 5

DAY: 2

BENCH PRESS	* 5 * 2
DUMBBELL PRESS	2 * 5
FORWARD RAISE	2 * 10
LATERAL RAISE	2 * 10
SEATED ROWS	3 * 8
TRICEP PUSHDOWN	3 * 6
BAR-BELL CURLS	3 * 6

COOL DOWN:

1. STRETCH: 5 MINUTES

NAME: _____

DATE: _____

WEEK 10

WARM UP:

1. BIKE RIDE
2. STRETCH 5 MINUTES

DAY: 1

BENCH PRESS * 3 * 2

DUMBBELL PRESS 2 * 5

TRICEP EXTENSION 3 * 5

HAMMER CURL 3 * 5

DAY: 2

BENCH PRESS * 8 * 2

DUMBBELL PRESS 2 * 5

TRICEP PUSHDOWN 3 * 8

BAR-BELL CURLS 3 * 8

COOL DOWN:

1. STRETCH: 5 MINUTES

APPENDIX F

DYNAMIC AND ISOMETRIC WEIGHT LIFTING PROGRAM

NAME: _____

DATE: _____

WEEK 1

WARM UP:

1. BIKE RIDE
2. STRETCH: 5 MINUTES

DAY: 1

BENCH PRESS * 8 * 2

ISOMETRIC WORK

1. (LOW) * 5 * 2
2. (HIGH) * 5 * 2

SHOULDER PRESS 3 * 8

LAT. PULLDOWN 3 * 8

TRICEP EXTENSION 3 * 8

HAMMER CURL 3 * 8

COOL DOWN:

1. STRETCH: 5 MINUTES

DAY: 1

BENCH PRESS * 8 * 2

ISOMETRIC WORK

1. (LOW) * 5 * 2
2. (HIGH) * 5 * 2

FORWARD RAISE 2 * 10

LATERAL RAISE 2 * 10

SEATED ROWS 3 * 8

TRICEP PUSHDOWN 3 * 8

BAR-BELL CURLS 3 * 8

NAME: _____

DATE: _____

WEEK: 2

WARM UP:

1. BIKE RIDE
2. STRETCH: 5 MINUTES

DAY: 1 _____

BENCH PRESS * 8 * 2

ISOMETRIC WORK

1. (LOW) * 5 * 2
2. (MED) * 5 * 2

SHOULDER PRESS 3 * 8

LAT. PULL-DOWN 3 * 8

TRICEP EXTENSION 3 * 8

HAMMER CURL 3 * 8

DAY: 2 _____

BENCH PRESS * 8 * 2

ISOMETRIC WORK

1. (LOW) * 5 * 2
2. (MED) * 5 * 2

FORWARD RAISE 2 * 10

LATERAL RAISE 2 * 10

SEATED ROWS 2 * 8

TRICEP PUSHDOWN 2 * 8

BAR-BELL CURLS 2 * 8

COOL DOWN:

1. STRETCH: 5 MINUTES

NAME: _____

DATE: _____

WEEK: 3

WARM UP:

1. BIKE RIDE
2. STRETCH: 5 MINUTES

DAY: 1

BENCH PRESS * 5 * 2

ISOMETRIC WORK

1. (LOW) * 5 * 2
2. (HIGH) * 5 * 2

SHOULDER PRESS 3 * 8

LAT. PULL-DOWN 3 * 8

TRICEP EXTENSION 3 * 8

HAMMER CURL 3 * 8

DAY: 2

BENCH PRESS * 8 * 2

ISOMETRIC WORK

1. (LOW) * 5 * 2
2. (HIGH) * 5 * 2

FORWARD RAISE 2 * 10

LATERAL RAISE 2 * 10

SEATED ROWS 2 * 8

TRICEP PUSHDOWN 3 * 8

BAR-BELL CURLS 3 * 8

COOL DOWN:

1. STRETCH: 5 MINUTES

NAME: _____

DATE: _____

WEEK: 4

WARM UP:

1. BIKE RIDE
2. STRETCH: 5 MINUTES

DAY: 1

BENCH PRESS * 5 * 2

ISOMETRIC WORK

1. (LOW) * 5 * 2
2. (MED) * 5 * 2

SHOULDER PRESS 3 * 8

LAT. PULL-DOWN 3 * 8

TRICEP EXTENSION 3 * 6

HAMMER CURL 3 * 6

COOL DOWN:

1. STRETCH: 5 MINUTES

DAY: 2

BENCH PRESS * 8 * 2

ISOMETRIC WORK

1. (LOW) * 5 * 2
2. (MED) * 5 * 2

FORWARD RAISE 2 * 10

LATERAL RAISE 2 * 10

SEATED ROWS 2 * 8

TRICEP PUSHDOWN 3 * 6

BAR-BELL CURLS 3 * 8

NAME: _____

DATE: _____

WEEK: 5

WARM UP:

1. BIKE RIDE
2. STRETCH 5 MINUTES

DAY: 1

BENCH PRESS * 8 * 2

ISOMETRIC WORK

1. (LOW) * 5 * 2
2. (HIGH) * 5 * 2

SHOULDER PRESS 3 * 6-8

LAT. PULL-DOWN 3 * 6-8

TRICEP EXTENSION 3 * 6

HAMMER CURL 3 * 6

COOL DOWN:

1. STRETCH 5 MINUTES

DAY: 2

BENCH PRESS * 8 * 2

ISOMETRIC WORK

1. (LOW) * 5 * 2
2. (HIGH) * 5 * 2

FORWARD RAISE 2 * 10

LATERAL RAISE 2 * 10

SEATED ROWS 2 * 8

TRICEP PUSHDOWN 3 * 6

BAR-BELL CURLS 3 * 6

NAME: _____

DATE: _____

WEEK: 6

WARM UP:

1. BIKE RIDE
2. STRETCH 5 MINUTES

DAY: 1

BENCH PRESS * 8 * 2

ISOMETRIC WORK

1. (LOW) * 5 * 2
2. (MED) * 5 * 2

SHOULDER PRESS 3 * 6

LAT. PULL-DOWN 3 * 6-8

TRICEP EXTENSION 3 * 6

HAMMER CURL 3 * 6

DAY: 2

BENCH PRESS * 8 * 2

ISOMETRIC WORK

1. (LOW) * 5 * 2
2. (MED) * 5 * 2

FORWARD RAISE 2 * 10

LATERAL RAISE 2 * 10

SEATED ROWS 2 * 8

TRICEP PUSHDOWN 3 * 6

BAR-BELL CURLS 3 * 6

COOL DOWN:

1. STRETCH: 5 MINUTES

NAME: _____

DATE: _____

WEEK: 7

WARM UP:

1. BIKE RIDE
2. STRETCH 5 MINUTES

DAY: 1

BENCH PRESS * 5 * 2

ISOMETRIC WORK

1. (LOW) * 5 * 2
2. (HIGH) * 5 * 2

SHOULDER PRESS 3 * 6

LAT. PULL-DOWN 3 * 6-8

TRICEP EXTENSION 3 * 4-6

HAMMER CURL 3 * 4-6

DAY: 2

BENCH PRESS * 5 * 2

ISOMETRIC WORK

1. (LOW) * 5 * 2
2. (HIGH) * 5 * 2

FORWARD RAISE 2 * 10

LATERAL RAISE 2 * 10

SEATED ROWS 2 * 8

TRICEP PUSHDOWN 3 * 6

BAR-BELL CURLS 3 * 6

COOL DOWN:

1. STRETCH: 5 MINUTES

NAME: _____

DATE: _____

WEEK: 8

WARM UP

1. BIKE RIDE
2. STRETCH 5 MINUTES

DAY: 1

BENCH PRESS * 5 * 2

ISOMETRIC WORK

1. (LOW) * 5 * 1
2. (MED) * 5 * 2

SHOULDER PRESS 2 * 5

LAT. PULL-DOWN 2 * 6

TRICEP EXTENSION 3 * 5

HAMMER CURL 3 * 5

COOL DOWN:

1. STRETCH: 5 MINUTES

DAY: 2

BENCH PRESS * 5 * 2

ISOMETRIC WORK

1. (LOW) * 5 * 2
2. (MED) * 5 * 2

FORWARD RAISE 2 * 10

LATERAL RAISE 2 * 10

SEATED ROWS 2 * 8

TRICEP PUSHDOWN 3 * 6

BAR-BELL CURLS 3 * 6

NAME: _____

DATE: _____

WEEK: 9

WARM UP:

1. BIKE RIDE
2. STRETCH 5 MINUTES

DAY: 1

BENCH PRESS * 3 * 2

ISOMETRIC WORK

1. (LOW) * 5 * 1
2. (HIGH) * 5 * 1

SHOULDER PRESS 2 * 5

LAT. PULL-DOWN 2 * 6

TRICEP EXTENSION 3 * 5

HAMMER CURL 3 * 5

COOL DOWN:

1. STRETCH: 5 MINUTES

DAY: 2

BENCH PRESS * 5 * 2

ISOMETRIC WORK

1. (LOW) * 5 * 1
2. (HIGH) * 5 * 1

FORWARD RAISE 2 * 10

LATERAL RAISE 2 * 10

SEATED ROWS 2 * 8

TRICEP PUSHDOWN 2 * 6

BAR-BELL CURLS 3 * 6

NAME: _____

DATE: _____

WEEK: 10

WARM UP:

1. BIKE RIDE
2. STRETCH 5 MINUTES

DAY: 1

BENCH PRESS * 3 * 2

ISOMETRIC WORK

1. (LOW) * 5 * 1
2. (HIGH) * 5 * 1

SHOULDER PRESS 2 * 5

LAT. PULL-DOWN 2 * 6

TRICEP EXTENSION 3 * 5

HAMMER CURL 3 * 5

DAY: 2

BENCH PRESS * 8 * 2

ISOMETRIC WORK

1. (LOW) * 5 * 1
2. (HIGH) * 5 * 1

TRICEP PUSHDOWN 3 * 8

BAR-BELL CURLS 3 * 8

COOL DOWN:

1. STRETCH: 5 MINUTES

APPENDIX G
F-SCAN SENSOR

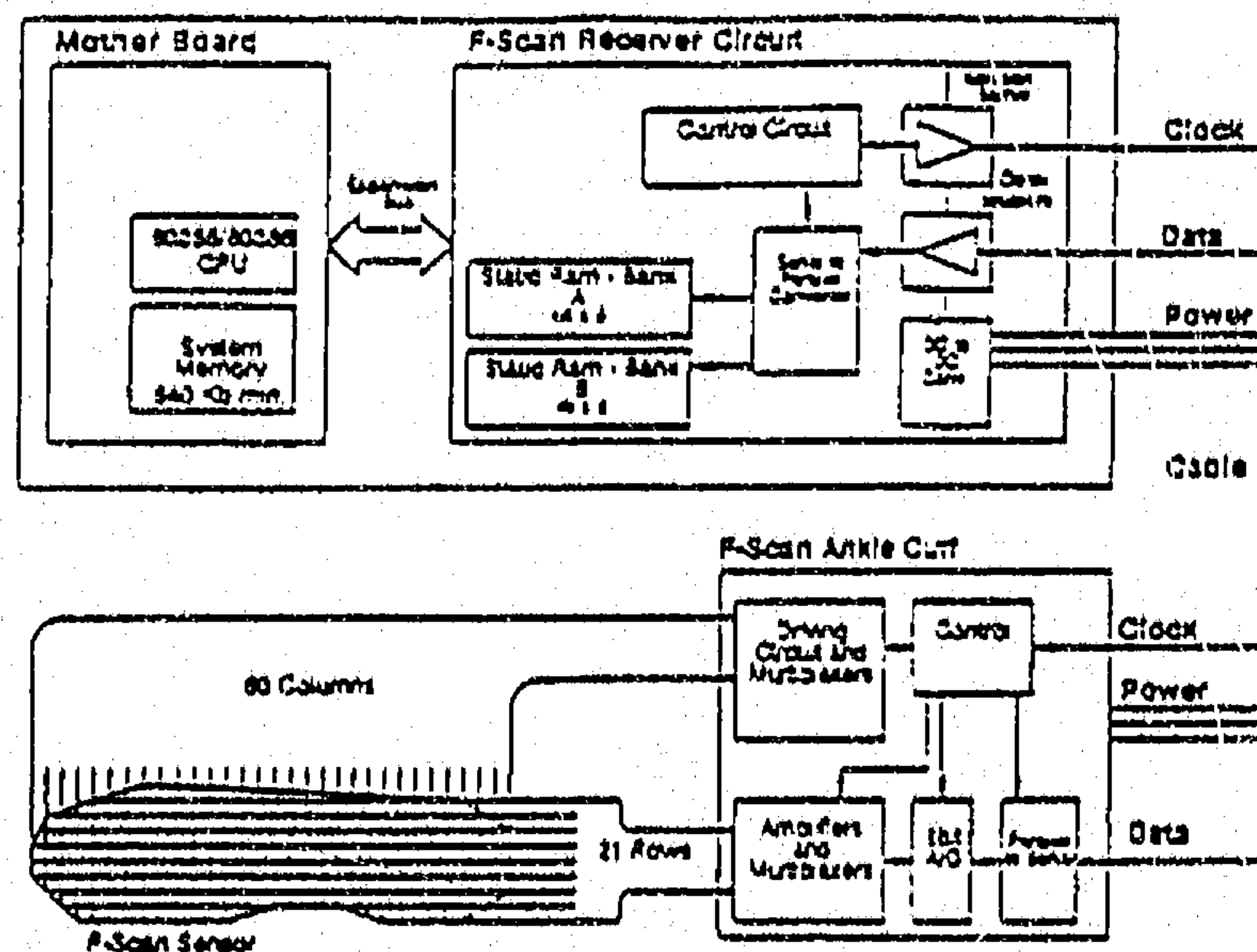


Figure 2. The F-Scan system's primary components are the flexible sensor, data collection electronics, and software. Details of the sensor itself are shown in Figure 3.

and system software (see Figure 2). It is designed for installation in any IBM 386-compatible PC with VGA level graphics support and at least a 40 MB hard drive.

The F-Scan sensor (see Figure 3) is the heart of the system. Its production methods were originally developed for flexible printed circuits, and it relies on a combina-

tion of conductive, dielectric, and resistive inks. As are all Tekscan sensors, the F-Scan sensor is characterized by a gridwork of rows and columns formed by silver based conductive ink deposition. Each sensing trace is coated with a pressure-sensitive resistive ink such that a sensing cell is created at each grid crossing point. Each

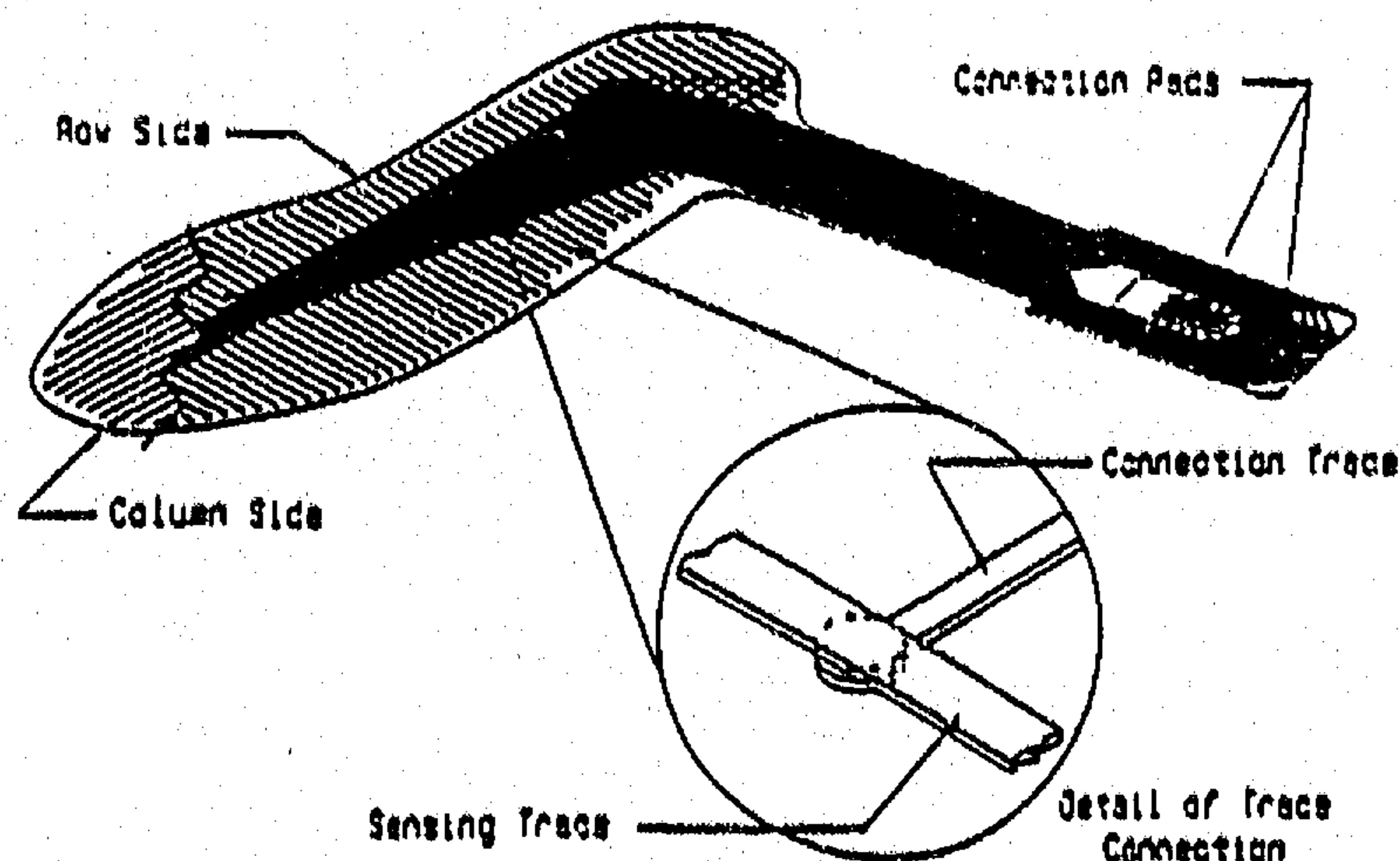


Figure 3. The F-Scan sensor uses a combination of conductive, dielectric, and resistive inks. Each sensing cell, located at a grid crossing point, has a resistance inversely proportional to applied surface pressure. The pressure distribution on the sensor's surface can be determined by scanning the grid and measuring the resistance at each intersection.

APPENDIX H
TRAINING PERCENT CHART

TRAINING BY PERCENTS: DYNAMIC LIFTING GROUP

	WEEK	1	2	3	4	5	6	7	8	9	10
SUBJECT MAX		60%	70%	75%	80%	65%	75%	80%	85%	90%	93%

(THIS WAS THE WEIGHT LIFTED BY THE SUBJECTS)

01	080.00	050	055	060	065	050	060	065	070	075	080
02	180.00	110	125	135	140	115	135	140	150	160	170
03	135.00	080	095	100	110	090	100	110	115	120	125
04	175.00	105	125	135	140	110	135	140	150	160	170
05	180.00	110	125	135	140	115	135	140	150	160	175
06	190.00	115	130	140	150	125	140	150	160	170	180
07	195.00	120	140	145	155	125	145	155	165	175	185
08	205.00	125	145	155	165	130	155	165	175	185	195
09	205.00	125	145	155	165	130	155	165	175	185	195
10	215.00	130	150	160	170	140	160	170	180	190	200
11	245.00	150	170	185	195	160	185	195	210	220	230
12	300.00	180	210	225	240	195	225	240	255	270	280

TRAINING BY PERCENTS: DYNAMIC AND ISOMETRIC WEIGHT LIFTING GROUP

	WEEK	1	2	3	4	5	6	7	8	9	10
SUBJECT MAX		60%	70%	75%	80%	65%	75%	80%	85%	90%	93%

(THIS WAS THE WEIGHT LIFTED BY THE SUBJECTS)

01	115.00	070	080	085	090	075	085	090	100	105	110
02	130.00	075	090	095	105	085	095	105	110	115	120
03	135.00	080	095	100	110	090	100	110	115	120	125
04	170.00	100	120	130	135	110	130	135	145	150	155
05	170.00	100	120	130	135	110	130	135	145	150	155
06	185.00	110	130	140	150	120	140	150	155	165	175
07	190.00	115	130	140	150	125	140	150	160	170	180
08	205.00	125	145	155	165	130	155	165	175	185	195
09	230.00	145	165	175	186	155	180	190	205	210	215
10	275.00	165	190	205	220	180	205	220	235	250	255
11	300.00	180	210	225	240	195	225	240	255	270	280
12	300.00	180	210	255	240	195	225	240	255	270	280

APPENDIX I

FUNCTIONAL ISOMETRIC LIFTING PROTOCOL

ISOMETRIC TRAINING PROTOCOL

The functional isometric exercises would be performed after the core lift (bench press) was done. Two of the three joint angles would be worked per training day. The 75 - 95 degree angle would be trained each workout that called for isometric work to be done. The other two joint angles would be worked on every other time.

There would be three joint positions at which isometric exercises would be performed:

Pletnev (1975) suggests.

<u>Position</u>	<u>Degrees (Elbow flexion)</u>	<u>Percent of Max</u>
1. Low	60 - 75	50% - 75% 1 (RM)
2. Medium	75 - 100	80% - 95% 1 (RM)
3. High	130 - 160	100% - 120% 1 (RM)

Tyzahelaza Atletika (1984) Suggested:

- A. 3 - 6 sets (per week)
- B. 2 - 5 reps (per set)
- C. 1 - 2 exercises (per week)
- D. 4 - 6 seconds (per hold)

ACTUAL LIFTING PROTOCOL

- * Lift at two joint angles per workout
- * Two sets of the exercise per joint angle
- * Isometric exercises would be performed twice a week
- * Isometric hold 5 seconds
- * There would be five reps per set for each exercise
- * Would follow Pletnev (1975) joint angle suggestions

ACTUAL ISOMETRIC WEIGHT LIFTING PROGRAM

<u>WEEK</u>		<u>LOW ISOMETRIC</u>			<u>MED ISOMETRIC</u>			<u>HIGH ISOMETRIC</u>		
1	DAY 1	60%	5	* 2				120%	5	* 2
	DAY 2	45%	5	* 2				105%	5	* 2
2	DAY 1	65%	5	* 2	100%	5	* 2			
	DAY 2	50%	5	* 2	85%	5	* 2			
3	DAY 1	70%	5	* 2				125%	5	* 2
	DAY 2	55%	5	* 2				110%	5	* 2
4	DAY 1	75%	5	* 2	105%	5	* 2			
	DAY 2	60%	5	* 2	90%	5	* 2			
5	DAY 1	80%	5	* 2				135%	5	* 2
	DAY 2	65%	5	* 2				120%	5	* 2
6	DAY 1	85%	5	* 2	110%	5	* 2			
	DAY 2	70%	5	* 2	95%	5	* 2			
7	DAY 1	90%	5	* 1				140%	5	* 2
	DAY 2	70%	5	* 2				125%	5	* 2
8	DAY 1	95%	5	* 1	125%	5	* 1			
	DAY 2	75%	5	* 1	110%	5	* 1			
9	DAY 1	100%	5	* 1				150%	5	* 1
	DAY 2	100%	5	* 1				120%	5	* 1
10	DAY 1	110%	5	* 1				155%	5	* 1
	DAY 2	110%	5	* 1				125%	5	* 1

* THE PERCENTS ARE BASED UPON THE 1-RM OF THE
(TG) TOUCH AND GO BENCH PRESS TEST.

APPENDIX J
RAW MEASUREMENT SCORES

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Subjects data who used dynamic weight lifting techniques

Subject	Pretest		Posttest		Improvement	
	BP.	DD ST	BP.	DD ST	BP.	DD ST
01	080.00	065.00	095.00	080.00	15.00	15.00
02	180.00	155.00	205.00	175.00	25.00	20.00
03	135.00	120.00	155.00	135.00	20.00	15.00
04	175.00	165.00	185.00	155.00	10.00	- 10.00
05	180.00	160.00	185.00	160.00	05.00	00.00
06	190.00	175.00	180.00	175.00	-10.00	00.00
07	195.00	175.00	215.00	185.00	20.00	10.00
08	205.00	185.00	225.00	210.00	20.00	25.00
09	205.00	185.00	215.00	180.00	10.00	- 05.00
10	215.00	195.00	230.00	205.00	15.00	10.00
11	245.00	235.00	260.00	245.00	15.00	10.00
12	300.00	275.00	305.00	265.00	05.00	- 10.00
Mean	192.10	174.16	204.58	180.83	12.50	06.67
S.D.	53.70	52.25	52.46	48.80	09.42	11.55

Subjects data who used dynamic and isometric lifting techniques

Subjects	Pretest		Posttest		Improvement	
	BP.	DD ST	BP.	DD ST	BP.	DD ST
01	130.00	105.00	170.00	130.00	40.00	25.00
02	115.00	095.00	145.00	125.00	30.00	30.00
03	135.00	155.00	185.00	175.00	50.00	20.00
04	170.00	145.00	195.00	165.00	25.00	20.00
05	170.00	145.00	205.00	175.00	35.00	30.00
06	185.00	175.00	225.00	215.00	40.00	50.00
07	190.00	175.00	215.00	195.00	25.00	20.00
08	205.00	185.00	230.00	210.00	25.00	25.00
09	230.00	220.00	265.00	245.00	35.00	25.00
10	275.00	225.00	300.00	250.00	25.00	25.00
11	300.00	255.00	325.00	275.00	25.00	20.00
12	300.00	225.00	315.00	275.00	15.00	50.00
Mean	200.42	174.65	231.25	202.92	30.90	28.40
S.D.	63.98	49.65	58.23	51.37	9.50	10.73