AN INSTRUCTIONAL MANUAL FOR USE OF THE ELGIN EXERCISE TABLE

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ELGIN EXERCISE TABLE

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TABLE OF CONTENTS

Chapter		Page
I.	INTRODUCTION	1
	Statement of the Problem	6
	Procedures	7
	Limitations of the Study	13
	Definition of Terms	14
II.	REVIEW OF LITERATURE CONCERNING PROGRESSIVE RESISTANCE EXERCISE	16
	Objectives of Progressive Resistance Exercise	18
	DeLorme's Exercise Principles	18
	Techniques of Progressive Resistance Exercise	20
	Organization of the Progressive Resistance Exercise Program	21
	Hazards of Progressive Resistance Exercise	21
	Early Beginnings of Progressive Resistance Exercise	23
	Heavy Resistance Exercise	24
	Progressive Resistance Exercise	25
	Modifications of DeLorme's Method	28
III.	REVIEW OF LITERATURE CONCERNING PROGRESSIVE RESISTANCE EXERCISE EQUIPMENT	32
	Early Equipment	33
	Eighteenth and Nineteenth Century Equipment	33
	Early Twentieth Century Developments	34
	Recent Twentieth Century Developments	39
	Conclusions	41
IV.	ELGIN EXERCISE TABLE	45
	Description of the Table	47
	Necessary and Important Attachments	52
	Available Accessories	60
	Conclusions	62

Chapter Page

V. EXERCISES FOR STRENGTH DEVELOPMENT 63

Neck Flexor Exercises 63
Neck Hyperextensor Exercises 65
Neck Lateral Flexor Exercises 67
Neck Rotator Exercises 69
Wrist Hyperextensor Exercises 71
Wrist Flexor Exercises 73
Wrist Radial Flexor Exercises 74
Wrist Ulnar Flexor Exercises 76
Wrist Supinator Exercises. 77
Wrist Pronator Exercises 79
Elbow Flexor Exercises 80
Elbow Extensor Exercises 82
Shoulder Abductor Exercises 84
Shoulder Horizontal Abductor Exercises 86
Shoulder Adductor Exercises 88
Shoulder Horizontal Adductor Exercises 89
Shoulder Flexor Exercises 91
Shoulder Extensor Exercises 93
Shoulder Lateral Rotator Exercises 95
Shoulder Medial Rotator Exercises 97
Shoulder Elevator Exercises 99
Upper Back Extensor Exercises 100
Trunk Extensor Exercises 102
Trunk Flexor Exercises 104
Trunk Rotator Exercises 105
Trunk Lateral Flexor Exercises 107
Hip Flexor Exercises 109
Hip Extensor Exercises 111
Hip Abductor Exercises 113
Hip Adductor Exercises 115
Hip Medial Rotator Exercises 116
Hip Lateral Rotator Exercises 119
Knee Extensor Exercises 121
Knee Flexor Exercises 123
Ankle Dorsi-Flexion Exercises 125
Ankle Plantar-Flexion Exercises 126
Ankle Inversion Exercises 128
Ankle Eversion Exercises 130

Chapter Page

VI. SUMMARY AND RECOMMENDATIONS 132

Summary 132
Recommendations for Further Study 133

SELECTED BIBLIOGRAPHY 135

APPENDIX 139

Personal Letter from Dr. Thomas L. DeLorme 140

LIST OF FIGURES

Figure		Page
1.	Complete Exercise Unit	46
2.	Boot Assembly	52
3.	Foot Drop Boot	55
4.	Pelvic Rest	56
5.	Shoulder Harness	57
6.	Small Weight Pan	60
7.	Neck Flexor Exercise: Supine	64
8.	Neck Flexor Exercise: Sitting	64
9.	Neck Hyperextensor Exercise: Prone	66
10.	Neck Hyperextensor Exercise: Sitting	66
11.	Neck Lateral Flexor Exercise: Side Lying	67
12.	Neck Lateral Flexor Exercise: Sitting	68
13.	Neck Rotator Exercise: Prone	69
14.	Neck Rotator Exercise: Sitting	70
15.	Wrist Hyperextensor Exercise: Prone	72
16.	Wrist Hyperextensor Exercise: Sitting	72
17.	Wrist Flexor Exercise: Prone	73
18.	Wrist Flexor Exercise: Standing	74
19.	Wrist Radial Flexor Exercise: Prone	75
20.	Wrist Radial Flexor Exercise: Sitting	75

Figure

Page

21. Wrist Ulnar Flexor Exercise: Sitting 76
22. Wrist Ulnar Flexor Exercise: Prone 77
23. Wrist Supinator Exercise: Standing 77
24. Wrist Supinator Exercise: Sitting 78
25. Wrist Pronator Exercise: Standing 79
26. Wrist Pronator Exercise: Sitting 80
27. Elbow Flexor Exercise: Sitting 81
28. Elbow Flexor Exercise: Sitting 82
29. Elbow Extensor Exercise: Half Sitting 83
30. Elbow Extensor Exercise: Sitting 83
31. Shoulder Abductor Exercise: Side Lying 84
32. Shoulder Abductor Exercise: Standing 85
33. Shoulder Horizontal Abductor Exercise: Standing 86
34. Shoulder Horizontal Abductor Exercise: Standing 87
35. Shoulder Adductor Exercise: Standing 88
36. Shoulder Adductor Exercise: Standing 89
37. Shoulder Horizontal Adductor Exercise: Sitting 89
38. Shoulder Horizontal Adductor Exercise: Standing 90
39. Shoulder Flexor Exercise: Supine 91
40. Shoulder Flexor Exercise: Standing 92
41. Shoulder Extensor Exercise: Supine 93

Figure Page

42. Shoulder Extensor Exercise: Standing 94
43. Shoulder Lateral Rotator Exercise: Supine 95
44. Shoulder Lateral Rotator Exercise: Sitting 96
45. Shoulder Medial Rotator Exercise: Supine 97
46. Shoulder Medial Rotator Exercise: Sitting 98
47. Shoulder Elevator Exercise: Standing 99
48. Shoulder Elevator Exercise: Supine 100
49. Upper Back Extensor Exercise: Prone 101
50. Upper Back Extensor Exercise: Sitting 101
51. Trunk Extensor Exercise: Prone 102
52. Trunk Extensor Exercise: Prone 103
53. Trunk Flexor Exercise: Supine 104
54. Trunk Flexor Exercise: Sitting 105
55. Trunk Rotator Exercise: Sitting 105
56. Trunk Rotator Exercise: Sitting 106
57. Trunk Lateral Flexor Exercise: Side Lying 107
58. Trunk Lateral Flexor Exercise: Sitting 108
59. Hip Flexor Exercise: Sitting 109
60. Hip Flexor Exercise: Standing 110
61. Hip Extensor Exercise: Prone 111
62. Hip Extensor Exercise: Standing 112
63. Hip Abductor Exercise: Standing 113

Figure Page

64. Hip Abductor Exercise: Side Lying 114

65. Hip Adductor Exercise: Side Lying 115

66. Hip Adductor Exercise: Standing 116

67. Hip Medial Rotator Exercise: Sitting 117

68. Hip Medial Rotator Exercise: Standing 118

69. Hip Lateral Rotator Exercise: Sitting 119

70. Hip Lateral Rotator Exercise: Standing 120

71. Knee Extensor Exercise: Supine 121

72. Knee Extensor Exercise: Prone 122

73. Knee Flexor Exercise: Prone 123

74. Knee Flexor Exercise: Prone 124

75. Ankle Dorsi-Flexion Exercise: Sitting. 125

76. Ankle Dorsi-Flexion Exercise: Supine 125

77. Ankle Plantar-Flexion Exercise: Supine 126

78. Ankle Plantar-Flexion Exercise: Sitting. 127

79. Ankle Inversion Exercise: Sitting 128

80. Ankle Inversion Exercise: Supine 129

81. Ankle Eversion Exercise: Sitting 130

82. Ankle Eversion Exercise: Supine 131

CHAPTER I

INTRODUCTION

From the beginning of time, man's existence has been strongly influenced by his strength and endurance. As the centuries passed, our commercialized and automated society evolved--one in which man needed only minimal strength and endurance to carry on his daily activities. Activities beyond this daily routine are rarely handled effectively and efficiently.

The impact such a style of living has on society is not to be felt lightly. Familiar to almost all Americans are the emotional stress of the urban rat race, the rich and plentiful food allowed us by our affluence and the ease of an era of machines. These are all threats to our health because all contribute to heart disease, which kills more Americans than any other single cause--almost a million a year (48:7).

The last decade has, however, been marked with increased interest in bodily development and conditioning through various forms of exercise. This interest is witnessed by the influx of individual body building programs for home use; the growth and spread of health spas and studios all over the country; the increased emphasis on physical rehabilitation of the hospitalized; the increased popularity of exercise equipment and conditioning classes in the physical education programs of today's schools and colleges; and the expanding research and scientific approach to conditioning our athletes.

Even with the expanding information concerning exercise and its benefits, there are still people who seek the "effortless way" to improve their body condition. These members of society turn to "gadgets" and "fancy machines" on the market with the end result being little more than a drained purse.

The more conscientious members of society are becoming more aware of the needs for and benefits of exercise and are taking part in such programs as jogging, aerobics, XBX, 5BX, progressive resistance exercise or weight training. These people are the ones who heed the warnings of the Food and Drug Administration who write, "Only exercise can solve our society's problems," and "Exercise can yield benefits only in direct proportion to the amount of human effort that goes into it" (48:91). These conscientious members of our society will not "fall game" to the manufacturers of the "gadgets" and "fancy machines" advertized in our magazines and newspapers, and on our television sets. Truly, these people will be the ones who will reap the full benefits of an exercise program.

It was not this writer's purpose to attempt to make an exhaustive study of the entire gamut of these exercise programs and the equipment utilized today, but rather to concentrate full attention on progressive resistance exercise (PRE) and the Elgin Exercise Table.

Progressive resistance exercise has developed into a valuable adjunct to conditioning during the last three decades. In the past, this program had its greatest value in hospitals, clinics, and physical therapy wards where the principles and methods employed were based on Thomas DeLorme's original concept or some modification of it (30:296). Progressive resistance exercise was seen as a successful method of

rehabilitation, a means of restoring or maintaining function in patients suffering from such disabilities as simple fractures, poliomelytis, multiple sclerosis, and amputations. Exercise equipment was developed with the hope of facilitating the administration of such a program, thereby enabling the therapist to control the resistance to the exercise and the range of motion through which the joint was to be moved.

Of the numerous pieces of exercise equipment designed for the administration of progressive resistance exercise, the Elgin Exercise Table, invented and manufactured by Thomas DeLorme and Jess Gannon in 1945, has played a particularly important role in the rehabilitation aspect of the medical field. More recently, this piece of PRE equipment has been purchased by many physical education departments in colleges and universities over the country. In many cases, it has been utilized in the correction of mild postural deviations, in developing strength in weak muscle groups and in adapting exercises to meet the specific individual needs of students enrolled in such classes as body mechanics, body conditioning, correctives and adapted physical education. A few educators have also seen this piece of equipment as a potentially valuable research tool, providing objective measurement and evaluation of exercises and their actual effect upon specific muscles.

The writer's initial interest in the Elgin Exercise Table was stimulated by Dr. Ruth Lindsey, who was instrumental in securing an Elgin Exercise Table for the Oklahoma State University Department of Health, Physical Education, and Recreation in 1968. Investigation of the manufacturer's specifications and the literature revealed a lack of information concerning the operation and effectiveness of the apparatus.

The background material presented in the accompanying manufacturer's manual was not complete. The objectives, principles, techniques, hazards, and organizational procedures involved in the proper administration of a progressive resistance exercise program utilizing the Elgin Exercise Table were not included in the manual. The methods of determining and applying the appropriate exercise load were not mentioned.

The manual failed to describe the actual operational procedures of the table and its various assemblies. No explanation was given as to how the various pulley assemblies were adjusted and attached for operation, utilized, or stored when not in use. In addition, it was not mentioned that a supplementary cable was needed in conjunction with the ones provided on the table to perform some of the exercises presented in the manual. In many of the exercises diagrammed in the manual, the complete length of the pulley's cable was not shown while in others, the path of the cable was drawn incorrectly. These errors and omissions make interpretation of the exercises quite difficult, especially when they are presented solely in pictorial diagrams.

Several assemblies, such as the hip abductor, hip rotator, special pulley and the boot carriage assemblies were not identified. The names given these various assemblies throughout this study were "coined" by the author to distinguish them from the other parts of the table. In addition, the manufacturer's manual did not explain how the assemblies should be attached for operation, whether they were adjustable along the frame, or whether they could be removed from the table when not in use. It was not explained that the hip abductor assembly should be attached to the overhead pulley and used in connection with the suspension cables or that the hip rotator assembly must be threaded with a

supplementary cable if it is to be utilized. In addition, the various knobs and wheels which control the boot carriage's excursion, angle, and height, as well as the ones adjusting the angle of the backrest were not identified or mentioned. In addition to the above, the means of attachment and utilization of the various supplementary accessories were not included in the manual.

In the manufacturer's manual, it is stated that nearly 100 progressive resistance exercises are presented. However, after carefully checking the exercises, it was found that only 44 actually utilize the pulley arrangement of the table; and only 35 of these were load-resisting exercises. The remainder could be performed on any plinth with the addition of the small weight pan or other available accessories.

The exercises presented in the manual are illustrated by diagrams with little or no accompanying descriptions. The introduction states that "the accompanying descriptions reduce reading material to a minimum and the arrows are generously employed to avoid repetition and promote clarity" (46:1). The writer agrees that "a picture is worth a thousand words," but pictures take on meaning only when understood. The manual's presentation does not, in the writer's opinion, promote the necessary understanding needed if the exercises are to be performed correctly. The pictorial diagrams do not present the much needed information concerning the proper positioning of the subject on the table, the areas which may need to be stabilized, the attachment of the cable to the body part to be exercised, nor the desirable joint range for a given effect.

In examining the manual, the writer discovered that two exercises were incorrectly presented. The exercises for the radial and ulnar

"deviators" presented on page four of the manual were incorrect. The exercise for the radial "deviators" is actually an exercise for the ulnar "deviators" and vice versa. The mistake may have been typographical; but the concern is if the individual administering the exercise did not know differently, the exercises for these two movements of the wrist would be done incorrectly because they are incorrectly presented.

The other exercises and suggestions in the manual seem to be limited in scope and as the physical therapists tell us, "You just have to use your imagination and creativity to make up your own exercises."

Statement of the Problem

The purpose of this study was to develop a more useful manual for the operation of the Elgin Exercise Table, Model A 1500, by:

(1) reviewing the literature on progressive resistance exercise in order to provide the initial background information needed to acquaint the author with its usefulness as an adjunct to strength development;

(2) comparing the values of the various pieces of progressive resistance exercise equipment in an attempt to gain new insights into the utilization of the Elgin Exercise Table;

(3) exploring the Elgin Exercise Table in an attempt to determine the operational procedures associated with the unit;

(4) explaining how the various supplementary attachments and accessories are utilized in conjunction with the Elgin Exercise Table; and

(5) presenting original exercises, utilizing the table's pulley arrangement, to supplement those in the manufacturer's manual and to demonstrate the versatility of the table.

Procedures

In order to acquaint the researcher with the necessary information and understanding of the techniques and principles involved in the proper utilization of the Elgin Exercise Table, a review of related literature was made.

First, the history of progressive resistance exercise and its inception into therapeutics and physical education were traced. The objectives, principles, techniques, and hazards of progressive resistance exercise were reviewed and enumerated. DeLorme's initial, as well as his subsequent programs and their modifications, were studied and presented in an attempt to provide additional background information on the proper operation of the Elgin Exercise Table as well as the organization and administration of an exercise program designed to develop body strength.

The literature reviewed contained only sparse referrals to the Elgin Exercise Table and its uses in the programs of physical education and therapeutics. Therefore, the writer attempted to gain new insights into the utilization of the Elgin Exercise Table by reviewing the literature on other progressive resistance exercise equipment and apparatus. Descriptions of the various pieces of equipment were included within this study. In addition, the physical therapists at the Veteran's Administration Hospital and the Children's Hospital in Oklahoma City, Oklahoma, were consulted in an attempt to obtain further information on the proper organization and administration of a program of progressive resistance exercise utilizing the Elgin Exercise Table.

Since the manufacturer's specification and the literature revealed a paucity of information concerning the operation and effectiveness of

the machine, the Elgin Exercise Table itself was studied by experimentation with and without subjects. An attempt was made to determine the operational procedures associated with the unit, as well as to determine how the various attachments and accessories were utilized. The complete Elgin Exercise Table was diagrammed, and its various parts and assemblies were labeled. Each part and assembly was described in detail, and its operational procedures were presented in hopes of facilitating understanding and enabling the operator to utilize the Elgin Exercise Table more efficiently and effectively.

Seventy-six original exercises, two for each joint movement, were devised through experimentation with subjects and through anatomical and kinesiological analyses. The following fourteen criteria were used as guidelines for the selection of these exercises.

General Criteria

(1) The exercises must be classified in terms of the movements of the various joints found in the body.

This was chosen as a criterion primarily because there are such wide discrepancies as to the specific action of muscles found in the human body. According to Cooper and Glassow (8:236),

> "It has been established that muscles do not always participate in the actions which their contractions could aid. Until further investigations enlighten us on muscle action in specific situations, we can say that contraction of extensors results in extension of a joint or that it prevents and controls flexion, and that at present it is accurate to speak only of muscle groups, not individual muscles."

(2) The exercises devised must utilize the pulley arrangement of the table.

This criterion was selected because the writer felt that exercises

not specifically utilizing the pulley arrangement of the table could be performed on any plinth with the addition of the small weight pan or other available accessories.

The table's pulley arrangement may be applied to the part of the body to be exercised, either directly by the cable's snap buckle or indirectly by using the cuffs, stirrups, harnesses, or boots. The use of the cables and pulleys allows the resistance offered by the weights on the weight pan to act in any direction.

(3) The exercises designed must utilize the pulley arrangement of the table for load-resisting purposes.

This criteria was felt to be of importance because it is an established physiological fact that contraction is the only means by which the strength of muscles can be maintained or improved (7:668). The strength of muscles lies in creating the conditions under which they are called upon to work to full (or near full) capacity against an ever-increasing resistance. Increase in strength and hypertrophy occurs in response to tension in the muscles set up by the factors which oppose their contraction (7:668).

Therefore, when the purpose of an exercise is the development of muscle strength, the overload principle should be applied (36:119). In the hospital setting, some patients may need "load-assisting" exercises; and some of these are included in the manufacturer's manual. The scope of this study does not permit their inclusion here.

(4) The exercises designed must be different from those presented in the manual.

This criterion was selected in order to show the versatility of the table and to provide a wider variety of exercises for strengthening

the muscle groups responsible for the various joint movements.

(5) The exercises and the table's arrangement should be relatively simple.

The exercise should be simple in relation to the ability of the subject to perform it accurately and vigorously (36:114). The exercise should be repeated with minimal resistance until the subject develops sufficient strength and skill to perform it with increased exercise loads. Complex exercises should be avoided (36:114).

In addition, the table's set-up should be relatively simple so that the operator does not have to spend a great percentage of his and his subject's time setting up the table and adjusting the various attachments and accessories during the exercise period.

Anatomical and Kinesiological Criteria

(1) The exercises should be ones which contribute to the comfort and safety of the subject and ones which are easily duplicated.

The elements of safety and comfort are important when exercising against increased exercise loads. The subject must be placed in an optimum position for exercising the particular muscle group needing strengthening. This position must be duplicated as nearly as possible from day to day if the full benefits of the exercise are to be realized. Small variations in the position may render the exercise load invalid by changing the length of the lever or the angle of pull and thereby the resistance which the subject is exercising (10:35-5).

In addition, accurate measurement and control of resistance are essential to prevent or avoid joint and muscle injury.

(2) Body parts should be stabilized as much as possible during the

exercises.

This criterion is important because many individuals will be unable to maintain the correct position unless parts of their body are stabilized during the exercise. In addition to incurring localization of an exercise, stabilization assists the subject in maintaining balance and helps to avoid strain in body parts not being exercised (36:115).

(3) The exercises must be localized to the body part in need of the strengthening.

This criterion is important because, according to Mueller and Christaldi (36:114), "Localization of an exercise permits concentrated thought and effort by the individual on exactly what he is expected to accomplish. It avoids the necessity for any effort, which otherwise would be required, to prevent movement in other freely moveable parts where action is not desired." Body position and stabilization procedures should prevent muscle substitution.

(4) The resistance should be applied at the distal end of the lever.

The resistance should be applied at the far end of the segment involved, just proximal to the next distal joint. This gives the applied resistance a much better lever arm than if the resistance were applied more proximally. With the resistance being applied most distal to the joint, a greater degree of effort is required to overcome relatively little resistance (16:8-13). The external force is maximally effective and has a much better lever arm than the opposing muscles.

In some instances, the lever is purposely shortened to prevent injury to weak joint structures. In this instance, it becomes easier to direct and grade the force opposing the muscle group. With the

shortened lever, more resistance must be applied to obtain the same or similar results as when the longer lever was employed (16:8-13).

(5) The most effective muscle pull is at right angles to the bone (54:89).

A muscle does exert its most effective pull at right angles to the moving bone; but when several muscles perform the same action at a joint, no two tendons will have the same angle of pull at any point in the range. Therefore, when the muscle group as a whole (i.e., elbow flexors) is being exercised, one cannot find a starting position in which all muscles would pull at a right angle.

If it were desired to exercise one particular muscle in that group (i.e,, biceps) without regards for the other participating muscles, it would be possible to find the optimum angle for that muscle.

When applicable, this principle was utilized in the exercises. Due to the fact that this study was designed to work with groups of muscles rather than single muscles, this principle was not applicable in all situations.

(6) The pull of the muscles should be in line with the pulley.

This criteria was selected because if the cable does not pull in line with the pulley, the pulley will not rotate freely and resistance will be increased (17:15-6).

(7) The exercises should allow a full range of movement within the joint being exercised.

The exercises designed should allow the joint to be moved through the full range of motion or in a selected range for specific exercise purposes.

In the exercises presented in the proposed manual, the pelvic and

thigh rest and the positioning of the body were utilized to allow greater range of movement during the exercise.

(8) A muscle is better able to exert active tension when it is in a lengthened state than after it has undergone shortening (8:220).

The exercise will be more effective if the muscle to be exercised is in its normal resting length or slightly stretched.

(9) The active tension exerted by a two-joint muscle at a given joint depends upon the position of the second joint over which it passes--since this determines its length (53:34-5).

Two-joint muscles are usually utilized for elongation over one joint while shortening at the other joint. Thus, they are more effective than one-joint muscles because they retain a favorable length through a larger range of movement; and their rate of shortening is less than that of one-joint muscles. To reduce the participation of a two-joint muscle in an exercise, the muscle should be shortened at the onset.

The pages which follow are the results of an attempt to design and compile a more useful manual for the utilization of the Elgin Exercise Table by correcting errors and omissions in the original manufacturer's manual and adding new suggestions for exercises.

Limitations of the Study

The following are limitations of this study:

(1) The Elgin Exercise Table was explored with reference to its utilization in the Physical Education Program as an adjunct to strength development. The possibilities of the use of the table were limited to the development of strength in the various muscle groups by

load-resisting exercises.

(2) The exercises presented were designed to utilize the table's pulley arrangement for active, load-resisting exercises. Exercises not specifically utilizing the table's pulley arrangement were not included.

(3) The exercises presented in the manufacturer's manual were not repeated in this paper. It was the hope of the writer that the information presented herein would enable the user to derive greater benefits from the use of the Elgin Exercise Table and be used to complement the manufacturer's manual.

(4) The original exercises presented in this study were based on anatomical and kinesiological analyses of the movements. No electromyographical data was collected.

Definition of Terms

Exercise Load: The exercise load refers to the resistance against which the exercise is performed.

Hypertrophy: An increase in the size of the muscle's fibers brought about by subjecting the muscle to greater exercise loads than those to which it is accustomed.

Isometric Contraction: A type of contraction which occurs when a muscle contracts against an immovable force.

Isotonic Contraction: A type of dynamic contraction which is performed when the muscle contracts concentrically or eccentrically, producing single or multiple joint movement.

Load-Assisting Exercise: Those exercises performed with the exercise load assisting the muscle.

Load-Resisting Exercises: Those exercises performed with the exercise load resisting the muscle.

CHAPTER II

REVIEW OF LITERATURE CONCERNING PROGRESSIVE RESISTANCE EXERCISE

Muscular strength has played a significant role in man's survival and progress since the beginning of human existance. From time immemorial, man has continued to search for means of increasing muscular strength in order that he might be able to carry on life's activities with an optimum level of efficiency and a minimum expenditure of energy. Recognizing the significant positive relationship between strength and health and strength and motor performance (51:7), physical educators, physical therapists, coaches and athletes have continuously sought better methods of augmenting muscular strength.

The relationship between exercising against a gradually increasing load and the development of strength has been known for a long time (11:6; 30:296; 33:68). In 1841, Bienaime wrote that "without resistance the exercise has no effect" (30:464). He believed that resistance to the exercise had to be increased gradually with a subsequent increase in the muscular effort needed to overcome it. However, prior to World War II the practice of increasing strength through progressive resistance exercise or weight training was confined largely to competitive weight lifters and the "strong men." Athletes were careful to avoid this method of training since their coaches felt that it caused detrimental effects such as "muscle-boundness" (30:464).

The fact that the attitude toward progressive resistance exercise has changed in the past two decades may have resulted from the pioneering efforts of an army surgeon, Thomas L. DeLorme, M. D., during World War II. Himself, a weight lifter, DeLorme was instrumental in introducing the equipment and techniques of this method of training into the Army's orthopedic treatment procedures. The system of progressive resistance exercise established and described by DeLorme is believed to have a sound physiological basis, and the muscles subjected to this type of exercise program have been shown to develop increased strength (11:ix). In fact, DeLorme is credited "with the development of such thorough principles and technics of resistance exercise that his system or some modification of it, is employed wherever good medicine is practiced today" (30:296).

Once the use of weights was found to have significant benefits in developing strength in the field of therapeutics, the opposition of the coaches and physical educators began to disappear (30:296). As a result, this method of training has experienced a tremendous growth of public interest. Weight training and progressive resistance exercise have become extremely popular among athletes as well as in programs of physical education as a useful adjunct to strength development (30:296).

In an attempt to acquaint the reader with Progressive Resistance Exercise, the objectives, principles, techniques, and hazards are presented in the following pages. In addition, DeLorme's initial and subsequent programs as well as their modifications are presented in an effort to provide additional background information and shed further light on the usefulness of such programs in the development of strength.

Objectives of Progressive Resistance Exercise

It is an established physiological fact that strength can be augmented significantly only by contracting against a degree of resistance that calls forth near maximal effort (21:27-9). As the contractile powers increase, the resistance against which the muscle works must become progressively greater and greater. The major resultant of any exercise system based on such a plan is the development of strength. Such then is the dominant objective of the progressive resistance exercise program. Additional outcomes of the PRE program of exercise are increased muscle strength and muscle efficiency with a resulting muscular hypertrophy. These exercises are being utilized today to overcome muscle atrophy, improve joint stability, and increase the general functional efficiency of the body (11:6-7; 21:27-9).

DeLorme's Exercise Principles

The basic principles or progressive resistance exercise have been, to a large extent, established empirically and based chiefly on the experience of professional weight lifters (11:7).

For centuries it has been known that if a person lifts progressively larger loads, the muscles, in response to the work stimulus, will hypertrophy and strength will increase. An extreme of what can be accomplished by such training was probably first realized in 1895 when a French Canadian who, while on his hands and knees, lifted 4,300 pounds off the ground (11:19-22; 33:67-9). Today there are weight lifters whose muscle power is almost unbelievable and whose weight lifting performance is as interesting and gratifying to watch as other sports. However, the methods of developing large muscles have been so exploited

in magazines that the mere mention of large muscles provokes some people to disgust. In some instances, such traits as "muscle bound", "tightened up", "slow", and "clumsy" have been attributed to those who participate in strength-type athletics and have helped to provoke negative attitudes (11:19-20). Only in the last three decades have these concepts of muscle physiology received considerable attention from a scientific viewpoint. The results of such investigations were the development of an effective therapeutic agent. This agent has, of course, evolved only after extensive modification and refinement of the original concepts (11:20).

According to DeLorme (26:318-20), the general principles on which the theories of progressive resistance exercise were developed are as follows:

(1) Low repetition, high resistance exercises produce strength.

(2) High repetition, low resistance exercises produce endurance.

(3) Neither of these types of exercise is capable of producing the results obtained by the other type.

(4) Weakened and atrophied muscles should not be subjected to endurance building exercises until muscular strength has been restored to normal by strength building exercises.

DeLorme felt that there are still many things which need further investigation if the principles of weight lifting are to be adopted for application in the program of therapeutics. Some of these are as follows: (1) the optimum resistance-repetition combination for producing hypertrophy; (2) the optimum frequency of exercise; and (3) the indications and contraindications for such strenuous exercise therapy (11:21).

Techniques of Progressive Resistance Exercise

Progressive resistance exercises are different from most types of remedial exercises because of their strenuousness. This fact makes it necessary to give more consideration to technical details for administering these exercises (11:35).

The elements of comfort and safety when exercising against a resistance become increasingly important with increased exercise loads. The subject must be placed in the optimum position for exercising the particular muscle needing strengthening. It is important to duplicate this position as nearly as possible from day to day if the full benefits of the exercise program are to be realized. Small variations in position may render the exercise load invalid by changing the lengths or angles of the lever or, advantages of muscle pull, and thereby the resistance against which the subject is exercising (11:35-6).

Since progress is dependent upon skillful adjustment of resistance to muscle contraction, accurate measurement and control of resistance are essential. For reasons of safety, comfort, efficiency and effectiveness, apparatus for the administration of progressive resistance exercise must of necessity be more elaborate than that employed in giving other exercises. Consequently, the devising of appropriate exercise apparatus was a large problem throughout the developmental state of the progressive resistance exercise program (11:3). The Elgin Exercise Table was constructed to meet the needs encountered within a progressive resistance exercise program. The table was designed to provide not only a wide range of exercises but also to permit these exercises to be performed in a very safe fashion. In addition, the table included enough flexibility to permit one to exercise most of

the major joints throughout the full or partial range of motion against most any resistance required (9:2). More thorough consideration is given the Elgin unit in the following chapters of this thesis.

Organization of the Progressive Resistance Exercise Program

It is difficult for a single exercise program to be adapted efficiently to the enumerable variations of muscle strength, joint range, deformities, ages, heights, and weights found in the subjects in need of such an exercise program. Therefore, a wide selection of available exercises should be devised to help reduce the monotony commonly associated with extended exercise regimes. There also must be a highly adaptable method of administering the exercises. Alternate programs of specific exercises may need to be improvised to meet the established needs of the subjects.

Hazards of Progressive Resistance Exercise

DeLorme (11:17) believes that there is only one potentially serious hazard and this becomes operative only when large muscle groups are exercised and the tension developed is high. This hazard is the Valsalva Phenomenon.

Under the conditions specified, progressive resistance exercise becomes an exercise of strain. If the students are not warned against holding their breath during the exercise, the effort is sometimes performed with the glottis closed and breathing is suspended during part or all of the movement cycle. This strong expiratory effort against the closed glottis results in a great rise in intrathoracic pressure. Meanwhile, the high intrathoracic pressure inhibits the return of

venous blood to the heart. As soon as the effort is over, the heart is surcharged with blood which has accumulated in the great veins during the effort. Heart size is now greater than normal due to passive dilatation and the stroke volume mounts to levels significantly above normal (11:17). Due to these circumstances, the subject may become dizzy or feel faint.

The most effective safeguard against this hazard is to instruct the subject in the proper breathing patterns. DeLorme (11:108) suggests that the subject should be taught to exhale, forcing air out of his lungs as he contracts his muscles and inhale as they relax.

It is obvious from the above that progressive resistance exercise of any severity may be contraindicated in subjects with abnormalities of the respiratory or circulatory systems. Thus, great caution should be exercised in the administration of activity of the progressive resistance type to the aged (11:17-18; 21:29).

Exercises of strain also elevate intra-abdominal pressure. Weakness or defect in the musculature or fascial layers of the abdominal wall become a second contraindication to severe progressive resistance exercises because of the danger of herniation (11:18). In this instance, the danger of herniation may be avoided by the proper supervision of the exercise program. The subject should not be permitted to exercise with excessive loads and the program should be founded on the principles previously described (11:13).

DeLorme, however, emphasizes that the causalities described are possible concomitants only of progressive resistance exercise involving large msucle groups with sufficient residual strength to develop high degrees of tension as a result of all-out activity of the subject.

Progressive resistance exercise is rarely carried on to these extremes by other than healthy young adult subjects. In the vast majority of cases, the degree of effort falls well below levels which might be dangerous (11:18).

Early Beginnings of Progressive Resistance Exercise

Progressive Resistance Exercise principles and technics as they are now employed had their inception in World War II. The urgent need for general hospital beds and for speedier rehabilitation of the wounded were directly responsible for the development of this exercise system in Gardiner General Hospital, Chicago, Illinois in the spring of 1944, and later in the Pope Memorial Exercise Clinic, Department of Physical Medicine, Massachusetts General Hospital, Boston, Massachusetts (11:1).

DeLorme, while assigned to the military hospital in Chicago, noted that following knee surgery, the quadriceps, which became so weak, so soon, and in so many patients, could be restored to full strength rapidly by increasing the resistance applied to exercising muscles (10:64-5; 11:1; 30:296).

The opportunity to test his principles of exercise in pathological conditions arose when Sergeant Walter Easley sustained a complete rupture of the cruciate and medial collateral ligament when jumping with full field equipment on his back. Due to the extreme instability of his knee, he was fitted with a permanent leg brace. Appealing to Dr. DeLorme for any sort of treatment that would permit him to remove the brace, Easley was offered DeLorme's completely untested heavy-weight-lifting type of exercise. For a month Easley exercised, directing every ounce of physical and mental effort toward the task. To the

amazement of everyone, all knee symptoms, pains, fluid, and buckling completely subsided. The brace was discarded, and the action of the knee was reported to be normal (11:12).

Col. John R. Hall, Commanding Officer of the Hospital, and Lt. Col. F. E. West, Chief of Orthopedic Surgery, recognized the therapeutic possibilities and encouraged the application of DeLorme's program not only to the remaining knee patients in the rehabilitation ward but also to the fracture patients. Equipment was borrowed or improvised and a physical therapy ward was constructed in the hospital. One-half of the ward was set aside for execution of the exercises which DeLorme had devised. Additional support and financial assistance were supplied by the Pope Foundation, Inc. and the National Foundation for Infantile Paralysis, Inc. Aid from these two foundations made it possible to develop equipment and techniques and to investigate the procedures and theories of DeLorme in a large number of clinical conditions (11:2-3).

Heavy Resistance Exercise

The first patients DeLorme treated with resistance exercises were soldiers suffering from muscle weakness following trauma. In the beginning the resistance was applied directly to the area to be treated; for example, a boot to which weights could be added was strapped to the foot to exercise the quadriceps extensor of the knee (30:296). The amount of weight used was the maximum amount the subject could move through the full range of motion ten times. This 10 repetitions maximum (10 RM) was determined once a week and a set of exercises based on this 10 RM was repeated 7 to 10 times during each exercise session. Exercise sessions were performed once a day for the first five days

of the week. The last two days of the week, the subject rested. On the fifth day, the maximum weight the subject could move once through the full range of motion (1 RM) was recorded and utilized to set the level of the 10 RM for the following week. This 1 RM was also used to evaluate the initial strength of the muscles and to record the improvement in strength at weekly intervals (10:649; 11:23-4; 32:296).

DeLorme referred to this method of strength development as "Heavy Resistance Exercise" because the weight utilized was greater in comparison to that utilized in previous strengthening methods and because an "all-out" effort on the part of the subject was needed to complete the exercises (32:296).

Progressive Resistance Exercise

After much experimentation, DeLorme realized that even muscles which could not contract against gravity could be strengthened if slight modifications in his original method of "Heavy Resistance Exercise" were made. In 1948, he revised his original method and adopted the name "Progressive Resistance Exercise (PRE)" (11:25; 32:297).

In addition to his original concepts, the principle of "counterbalancing" was incorporated as a means of exercising muscles too weak to complete a full arc of motion against gravity. By means of a system of pulleys, and a counterbalancing load, the weight of the extremity to be exercised was offset thereby permitting the weak muscles to carry the joint through its full range of movement.

DeLorme divided his progressive resistance exercise system into two important areas: "Load-assisting exercises" and "Load-resisting exercises." Load assisting exercises applied to those in which the

load with which the exercise was performed (exercise load) assisted the muscle. The term load-resisting exercises referred to those in which the exercise load resisted the muscle (11:23).

In the load-resisting exercises the increase in exercise load was based on the 10 RM as previously described. As the muscular strength increased, the 10 RM increased. However, in the load-assisting exercises, the situation was quite the opposite. In this technique, the exercise load was based on the 10 Repetitions Minimum. This was the load which made 10 repetitions barely possible. Therefore, the load which the muscle had to actually overcome during the exercise was increased by decreases in the resistance (11:23-4).

In his initial publication concerning "Heavy Resistance Exercise" DeLorme advocated seven to ten sets of exercise with 10 RM per set. With further experience, he discovered that this figure was much too high, and that in most cases a total of two to three sets of 10 RM per set was satisfactory. He felt this permitted exercise with even heavier loads and thus enabled a more rapid gain in strength and muscle volume. In addition, in his newer method, the initial one or two sets of repetitions were considered as a "warm-up" for the 10 RM exercises. This "warm-up" was thought to have significantly beneficial effect on subsequent performance (10:654; 32:297).

DeLorme suggested the following method of determining the approximate exercise load for each set of 10 repetitions:

Load Resisting Exercises (11:24)

First set of 10 repetitions	Use 1/2 of 10 RM
Second set of 10 repetitions	Use 3/4 of 10 RM
Third set of 10 repetitions	Use 10 RM

Example: Let us suppose that at the end of one week the subject can flex the elbow once (1 RM) through the full range of movement, against eight pounds of resistance. This 1 RM determines the 10 RM for the next week. If the 1 RM was 8 pounds, the schedule would be as follows: for the first set of 10 repetitions, use 4 pounds of resistance; for the second set of 10 repetitions, use 6 pounds of resistance; and for the third set of 10 repetitions, use 8 pounds of resistance.

Load Assisting Exercises (11:24)

First set of 10 repetitions	Use twice 10 R Minimum
Second set of 10 repetitions	Use 1 1/2 times 10 R Minimum
Third set of 10 repetitions	Use 10 repetitions Minimum

Example: Let us suppose the subject cannot flex the elbow against gravity due to atrophy in the flexors. The 10 RM is determined by starting with an "assisted" load that makes flexion possible for the weak flexors more than 10 repetitions. Then, by gradually reducing the "assisted" load, we find the least "assistance" the flexors must have in order to perform 10 repetitions. If this "least assistance" was found to be equal to 4 pounds, the schedule would be as follows: for the first set of 10 repetitions, use 8 pounds of "assistance;" for the second set of 10 repetitions, use 6 pounds of "assistance;" and for the third set of 10 repetitions, use 4 pounds of "assistance."

The foundations upon which DeLorme based these formulae was that gradually working up to 10 RM would prevent muscle soreness, teach the subject the exercises as they became more strenuous, alter the concept of the subject toward strenuous exertion and teach him how to exert a maximum effort. In addition, DeLorme felt that it would aid the subject in gradually adjusting to the discomfort of maximum exertion (11:27).

The usual frequency of exercise advocated by DeLorme was one bout daily, four days each week. However, there was no fixed frequency. Experience taught him that the five day-a-week, as in his initial plan, was usually the heaviest schedule that could be employed without the subject developing signs of delayed recovery from the exercise bout. In addition, DeLorme believed that three exercise bouts per week offered the minimum frequency with which exercises could be performed effectively. However, he felt that once strength had been developed it could be maintained at a high level, indefinitely, by exercising one to two periods weekly. More than one strenuous workout daily was not recommended (10:646; 11:28).

Modifications of DeLorme's P R E Method

Modifications of the DeLorme "Progressive Resistance Exercise" technique have been made by other investigators, notably McGovern and Luscombe (34:475-8). They advocated a reversal of the load-resisting schedule and a reduction in the number of preliminary exercises before performing the 10 RM. They recommended using the full 10 RM in the first set and one-half 10 RM in the third set (34:475-8).

Zinovieff, and subsequently, MacQueen advocated the "Oxford Technique" (32:298). This technique employed a high repetition exercise series (7 to 100 repetitions) with progressive decreases in the load while maintaining maximum tolerance load to compensate for fatigue. In the Oxford Technique, the first set was 10 RM; and in each successive set, the load was progressively lowered by about one pound while the 10 RM was increased each day by the same amount of weight.

Rudd (45:775-9), stimulated by the report of Hettinger and Muller

on the value of brief isometric contractions, tried still another variant of isotonic resistance exercise--Brief Maximal Exercise (BME). He positioned his subjects for weight loading of the quadriceps according to the manner popularized by DeLorme, and determined the maximal lift which the quadriceps could support for five seconds when the knee was fully extended from the potition of 90 degrees flexion. He found that the maximal lift was about one to one and one-fourth pounds. He employed about two-thirds of the load the muscle could lift once, and advocated resistance exercises using this value repeated six to twenty times, one to three periods daily, with rest intervals of a few minutes between each series of exercises.

At the California Rehabilitation Center, Santa Monica, California, all exercises employed the principle of resistance exercises using maximal resisted load. These exercises were grouped under the heading of "pulley weight exercises." The muscles were loaded maximally and the load increased at weekly intervals or less. The exercises were performed from 10 to 15 times with adequate rest periods between repetitions. Fatigue and endurance were used as the guiding criteria for determining the number of exercises, both as to frequency and duration. Adequate rest periods were provided by changing the exercises from one region of the body to another. The exercise periods lasted approximately 50 minutes for each period of pulley exercises (32:279).

The method chosen for strengthening normal muscle which has undergone disuse atrophy was heavy resistance with weights applied directly or indirectly. A progressive decrease of repetitions and an increase in load, as practiced by competitive weight lifters, was found to be the most efficient approach (32:279). For practical purposes, the

10 RM or some modification of it was believed to be adequate (32:279).

Berger, in 1962, presented a systematic investigation of the value of varying numbers of repetitions on the development of strength. The results of his study seemed to indicate that fewer repetitions (four to eight) were more effective in terms of strength gain (4:329-33).

In many clinics, a schedule has been used in which the weight was increased and the number of repetitions was decreased until the desire level of strength was attained. For example, when a total of 15 repetitions had been reached in an exercise period, the weight was increased to the point where only eight to ten RM could be lifted. If after several daily sessions the subject was again able to perform 15 repetitions, the weight was again increased and the subject exercised with the new load until 15 repetitions were executed (32:304-6).

Another modification in the method entailed the completion of the basic set of 10 RM in a shorter period of time. Greater strength was needed to complete 10 RM in six seconds than in ten seconds. Thus, when the subject gained enough strength to do the 10 RM in six seconds, the load was increased to the point where ten seconds was required and the subject once more strived for the goal of completion of the set in ten seconds (32:304-6).

On the basis of the findings of DeLorme and others (11:3), one could set up and prescribe a program of progressive resistance exercise based on the determination of the appropriate exercise load, and observance of the necessary precautions in protecting the health and safety of the subject. However, the proper administration and effectiveness of the program will depend upon the availability of the necessary tools.

These tools, which are so essential to the progressive resistance program, are explored in the next chapter.

CHAPTER III

REVIEW OF LITERATURE CONCERNING PROGRESSIVE RESISTANCE EXERCISE EQUIPMENT

The majority of writers agree that in no other type of exercise is equipment as important as it is in progressive resistance exercise. Specially designed apparatus for the administration of Progressive Resistance Exercise is demanded to insure the safety and comfort of the subject, and especially for utilization of increased exercise loads where accurate measurement and control of resistance are essential. Efficient, versatile exercise equipment is believed to help insure correct administration of the exercise programs as well as to aid in the determination of optimum exercise positions, resistances, and limitations (11:3, 35-6).

The development of appropriate exercise equipment and apparatus has been a primary problem throughout the entire developmental stage of this exercise regime (9:2). Equipment of all shapes and sizes has been devised in an attempt to facilitate the administration of the proposed program of progressive resistance exercise.

In an attempt to determine and compare the values of the devised progressive resistance exercise equipment and gain new insights into the utilization of the Elgin Exercise Table; the literature on progressive resistance exercise equipment and apparatus was thoroughly reviewed. The following chapter is a review of that literature

pertaining to the equipment necessary to an effective program of progressive resistance exercise.

Early Equipment

The first reference found which pertained to exercise equipment designed for the addition of weights and utilized in progressions referred to the "halters" of the Ancient Greeks (30:427). Resembling the modern dumbbells, they were made of different substances in different shapes, of which the ellipsoid was probably the most popular. These "halters" were weighted with lead in different quantities and utilized in progressions to develop strength in the upper and lower extremities.

Toward the end of the fifth century, Caeluis Aurelianus made a remarkable contribution to the treatment of paralysis of the different parts of the body (30:433). Initial treatment included the use of bandages and a pulley system designed to aid the patient in mobilization of the paralyzed area. When movement became possible and the subject could walk without support, Caelius added lead weights to their shoes, first in small amounts and then gradually more and more. In addition, Aurelianus advocated the use of progressively heavier dumbbells to further facilitate strength development (30:433).

Eighteenth and Nineteenth Century Equipment

Until the 18th century, little emphasis was placed on exercise equipment except of the sports apparatus nature. However, during the second quarter of this century, increasing attention was paid to exercise equipment for facilitation of strength. Tiphaine invented a highly secret device in 1772 (30:446). There are no illustrations or

descriptions of this machine in the literature, but Licht states that "it was probably a treadle and pulley device with which it was possible for one set of extremities to give assistive motion to the others" (30:446).

In 1865, Gustav Zander became interested in the use of weights, wheels, and levers as a means of eliminating the need for the constant assistance of a gymnast in exercise programs. With further experimentation, he developed 71 different types of apparatus for active, assistive, and resisted exercise and massage. Although detailed descriptions of his exercise apparatus were not available, Licht (30:451-2) reported that "they were first powered by the patient, later by steam engines, and still later by electric motors." In addition to devising exercise equipment, Zander made "dosage" more exact by using weights of known size and levers with graduated rules. He further stressed "localization" of the action by mechanical positioning (30:452).

Early Twentieth Century Developments

Fremont A. Chandler designed and devised a table in the early 1930's to expedite the mobilization of the shoulder joint and serve as an adjunct to strength development. This special table was 43 inches high, 86 inches long, and 23 inches wide. There was an arm hole, 9 inches in diameter, placed 25 inches from the head end of the table and 7 inches from each side (19:545-55). The subject lay prone on the table, with the arm to be exercised through the hole in the table top. Weights were added to the arm and movement was made from this position.

Perhaps, the greatest stimulus of all to therapeutic exercise and the first serious effort made to formalize a clinical technique

designed to develop muscular strength in as short a time as possible came from a young Alabama physician, Thomas L. DeLorme (30:452).

DeLorme became interested in different types of strength exercises while suffering from a chronic illness at 14. Upon receiving his medical degree and entering the Army in 1943, he became extremely interested in the use of progressive resistance exercise as a means of rehabilitation. At Gardiner General Hospital in 1944, he undertook a program to investigate the effectiveness of progressive resistance exercise on different conditions. When he found that patients needing a program of progressive resistance exercise could not use the routine athletic equipment, he began to devise equipment that would be adaptable to their needs (9:1).

Initially, separate devices for exercising each joint were designed. Among these were a quadriceps table, a stand for hip exercises, a "rack type affair" for back exercises, an abdominal tilt board, and a table for shoulder and hand exercises. As time passed, an attempt was made to devise one piece of apparatus which would take the place of all the other pieces of equipment. The Elgin Exercise Table was the result of such an attempt, and in 1946 the first table was sold commercially (9:1).

The table was constructed with the complicating factors of the older age groups in mind. In addition, the table had to provide a wide range of activities, allow the careful and safe administration of exercises, and allow exercises through the full or partial range of movement with most any degree of resistance applicable. DeLorme, in planning and devising this table, also made allowances for both load-assisting and load-resisting exercises (9:2).

Weights, pulleys, levers, and various types of halters and measuring devices were arranged and constructed on this table. By arranging this equipment properly and placing the subject in a suitable position, over 100 resistance exercises could be performed exercising most of the muscle groups of the body. The principle of maximal resistance and slow repetitions of the exercise was suggested as the basic exercise procedure. Two methods of loading the muscle were employed: (1) the resistance weight was added to the natural weight of the part to be moved, and (2) the load was arranged to counterbalance a desired amount of gravitational force while at the same time developing strength in weakened muscles unable to contract against gravity (21:25).

In 1945, several remedial exercisers were developed by the Chiefs of Physical Medicine in the larger hospitals in the East (55:275-9). An "improved" ankle exerciser was devised for the earlier stages of reconditioning as a prescribed form of remedial exercise. It utilized four coil springs under a cross-shaped shoe sole mounted on a metal ball and socket joint and was designed to specifically exercise the evertors and invertors of the ankle. To obtain the greatest benefit from the apparatus, the patient was instructed to stand on the lower rung of a stall-bar with his good foot and place the weakened foot in the exerciser. This position allowed his body weight to add to the resistance provided by the muscles exercising the ankle joint (55:275-9).

In that same year, a forearm and arm exerciser was devised to obtain better functional end results of injuries causing limitations of pronation and supination (55:275-9). This piece of equipment was constructed by utilizing a revolving circular handle measuring eight

inches in diameter bolted to a large wooden disc twelve inches in diameter. This disc was calibrated in degrees and mounted on a three-fourths inch by three inch horizontal wooden bar fifteen inches long. A fifteen inch coiled spring was attached by screw bolts at the outer ends to a wall and attached at the central ends to the revolving disc (55:275-9).

In 1952, Captain Dorothy L. Kenske devised a simple piece of equipment for exercising the ankle in six positions (24:634-8). Her ankle exerciser was very similar to the DeLorme Boot but was thought to be useful if one's budget was limited.

Goldthwait and Lieber devised a table in 1953 with the purpose of providing a means of easily obtaining full range of motion of the extremities with the patient in the prone position (18:545). The table top was divided into three sections. The center section supported the body and remained stationary while the moveable head and foot sections supported the arms and legs respectively. Electric motors working through reduction gears turned the drums on which the wound wires were attached to the four corners of each of the moveable table tops. Switches at the side of the table, within the easy reach of the physical therapist, controlled the motors. The limit switches automatically stopped the table top at the fully raised or fully lowered positions. With the table top lowered, weights and other resistance techniques were employed to add resistance to the desired movement through the prescribed range of movement (18:545-8).

In 1954, Noland and Kuckhoff devised an adapted progressive resistance exercise apparatus to provide physical therapists with a more efficient and convenient device for administering progressive

resistance exercise to the quadriceps femoris and hamstrings muscle groups (37:333-7). It was very similar to the knee flexion and extension section of the well known Universal Gym apparatus.

In this same year, W. Von Dobeln developed the Bicycle Ergometer (14:147). This instrument was a stationary bicycle whose front or back wheel was driven by the subject. The resistance against which the subject pedaled was provided by a frictional band or by an electromagnetic braking system. The workload could be quickly and easily adjusted by changing the tension of the brake band or the electromagnetic load across the generator. Work was calculated easily from a scale reading, which provided the frictional resistance and from the counter that recorded the number of times the wheel had turned (52:222). These characteristics give advantages for the testing of the subject for research and physical fitness purposes and people are utilizing this instrument, or some modification of it, for exercise purposes in the home, clinic, or gymnasium.

George Louis devised a table for mechanically resisted exercises in 1959 (31:405-7). This table allowed the subject to start exercising when his muscles were graded as "poor." As the muscles increased in strength, gradual resistance was applied by means of the pulley system on the table. Resistance was transmitted from weights placed in a weight receptacle connected to a nylon line passing over a stationary wall pulley. The line then entered the table by way of a stationary pulley at the rear of the table. Shortly after entering the pulley, the line was joined to a short bar receiving four lines coming from the pulleys on the tables "wings." Four swivel type pulleys were used at the front end of the table to enable the resistance to be transmitted

to the pulleys on top of the table. Resistance to the motions of the lower extremities could be applied as well as to various arm motions. In addition, Louis stated that "the table could also be utilized for passive stretch of most of the muscle groups by reversing the procedures for the resistance exercises" (31:405-7).

Recent Twentieth Century Developments

In 1962, Thomas J. Bender devised a multiple angle testing unit (3:1-2). This unit was especially designed for the isometric testing of the relative strength of muscle groups of the upper and lower extremities at various points in the range of motion. However, resistance exercises could also be performed utilizing the mechanics of the table for the same muscle groups. The actual testing was accomplished from a variety of positions ranging from sitting, standing, prone, supine, or a side lying position on the table. Bender believed that the table would permit consistency of technique in testing and re-testing the subjects since the unit and subject could be relocated in the same position each time (3:2).

The unit consisted of a treatment table, stablizing straps, force gauging system, rotating angle arms, vertical bar, activator unit and cable, V-Block, back and abdominal braces, adjustable wrist-ankle cuffs, and adjustable thigh cuffs. The force gauging system, accurate to 1%, registered the force applied at a given point in the range of motion for a quantitative analysis. The rotating arm, moving in a 34 inch arc from the end of the table, could be locked into position at every 5 degrees in the arc. The vertical bar could be moved up and down on the angle arms. The activator unit and cable, located on the vertical

bar, could be rotated to either side and locked into position (3:1-2).

In 1967, Perrine presented a new concept of resistance exercise, "Isokinetic" (39:43). As a result an isokinetic device, "Cybex Exerciser", was designed and manufactured by Technician, Cybex, Inc., to provide suitable mechanical means of achieving the objectives of this new system of exercise.

Isokinetic exercise employed a simple physical principle for loading a dynamically contracting muscle at a mechanically fixed rate of speed. The resistance offered was in direct proportion to the amount of force exerted by the subject throughout the full range of the movement (20:280; 39:43).

To load the muscle, utilizing the isokinetic principle, a special mechanical device was required. The isokinetic exerciser, "Cybex", consisted of a unique speed-controlling mechanism which acted as a speed-governor during an exercise motion. The lever arm was attached to a part of the body and carried through that segment's range of motion. Initial to the movement, the speed of the motion was pre-set according to the subject's level of ability in the muscle being trained. The subject then performed the movement against the resistance offered by the machine. As the muscle strength varied through the range of movement, the resistance caused by the speed-governing action fluctuated accordingly and accommodated the muscles' strength at every point in the range (20:280-2; 39:43). As the strength increased, the resistance kept pace assuring constant utilization of the overload principle. This exercise system was utilized to strengthen quadriceps and hamstrings; to increase, measure, and record range of motion; and to treat post operative meniscectomies. The mounting of the Cybex was designed

for easy attachment to any standard treatment table. It could then be operated from any position on the table or from a standing or sitting position next to the table (39:44-5).

Throughout the ages, weight trainers have developed a variety of apparatus to utilize in their strength development programs. However, during the last few years, many of the training apparatus have been combined into one unit, the Universal Gym. This unit has been enthusiastically approved by many coaches and athletes as an essential adjunct to their conditioning programs (47:2).

The Universal Gym, 1970, exercises most of the muscle groups in the body and was designed to accommodate men, women, and children of all ages and strength groups. Since "individual supervision is not necessary, large groups of students can be programmed for exercise in a single class period" (47:2). In addition, the weights utilized in offering resistance were positioned so that they cannot come in contact with the user even when mishandled.

The newest Universal Gym (47:2), offers isotonic resistance exercises at 15 stations, including the following: a leg and hip conditioner, chest press, shoulder press, high lateral pull station, quadriceps and dead lift station, chinning station, dipping station, hip flexor station, abdominal conditioner, thigh and knee machine, back hyperextension and swimmer kick station, rowing station, wrist conditioner, neck conditioner, and hand gripper station. In addition, it is possible to convert these stations for isometric exercises.

Conclusions

The review of literature revealed that a great variety of exercise

apparatus has been developed to facilitate the administration of a program of progressive resistance exercise. Comparatively few possess sufficient possibilities for the administration of the full gamut of exercises encompassed in a progressive resistance exercise program suitable for corrective or adapted purposes. In the writer's opinion, the Elgin Exercise Table is such an apparatus.

The Elgin Exercise Table Model A 1500 has been especially designed for the administration of exercises for all major joints of the body with the exception of those of the fingers and toes (46:1). The unit makes possible the administration of load-assisting and load-resisting exercises for muscle groups of the ankle, knee, hip, trunk, shoulder, elbow, wrist, and neck. In addition, the unit assures a consistency of positioning, techniques, and loading as well as an accurate method of evaluating muscle strength.

The unit may be used for all types of resistance exercises in which the resistance can be varied from a few ounces to several hundred pounds. The apparatus may also be utilized to administer passive exercises, passive stretching, and cervical traction. In addition, it is felt that the Elgin Table can provide a wider variety of selected exercises, thereby decreasing the monotony of one established exercise pattern. These advantages make it a good tool to utilize in corrective and adapted classes where the exercises must be individually prescribed. It is also felt that the Elgin Table has beneficial research possibilities in substantiating or disproving some of our theories of exercise.

Therefore, without trying to say that one piece of equipment is better than the other, it was the belief of the writer that the Elgin Exercise Table can provide a means of achieving all the purposes of

the previously described equipment, with the possible exception of the Cybex Isokinetic Device and the Universal Gym, 1970.

In utilizing the Elgin Table, the resistance applied to the muscle to be exercised must be in proportion to the strength of that muscle in the weakest point of its range of movement. This fact results in the resistance not being exactly proportional to the amount of force exerted by the subject throughout the full range of movement, as in the Cybex Isokinetic System. However, the Cybex was particularly designed for strengthening the quadriceps and hamstrings without reference to the remainder of the muscle groups. Neither is the Cybex designed for utilization of load-assisting exercises, or passive, passive stretch, or cervical traction. It is felt that these facts make the Elgin Table more appropriate to the administration of a complete correctives or adapted program of exercises.

The only problem associated with the use of the Elgin Table in the physical education setting is the fact that only one subject can utilize the table at one time. However, the table was never meant to be utilized in the mass conditioning program of subjects as it was designed for rehabilitation in a clinical setting.

In comparison, the Universal Gym is a useful tool for utilization in the mass conditioning program as it provides apparatus for strength development at 15 stations. However, no provisions are made for load-assisting exercises for the subjects too weak to perform the standard exercises. In addition, the body parts cannot be stablized, and all muscle groups cannot be exercised effectively.

If the desired results are to be realized, the exercise program must be accurately controlled and administered. Since the Elgin

Exercise Table has been designed and developed especially to meet these requirements, it is felt that the unit could help to eliminate the necessity of constantly improvising apparatus.

CHAPTER IV

ELGIN EXERCISE TABLE

The Elgin Exercise Table has played a particularly important role in rehabilitation in the medical setting for some years. More recently, this piece of progressive resistance exercise equipment has been purchased by several physical education departments in colleges and universities over the country.

At present, physical educators as well as physical therapists are faced with a difficult problem concerning the utilization of the Elgin Exercise Unit. Investigation of the manufacturer's specifications and the literature reveals a lack of information concerning the operation and effectiveness of this machine. The manual which accompanies the table leaves much to be desired. There is a lack of information concerning how the table actually operates and how the various complementary pieces of equipment are utilized. The suggestions offered in the manual are very limited in scope; and as physical therapists tell us, "You just have to use your imagination and ingenuity in discovering how the table operates."

The purpose of this chapter was to explore the Elgin Exercise Table in an attempt to discover the operational procedures associated with the unit, as well as to determine how the various complementary pieces of equipment could be utilized.

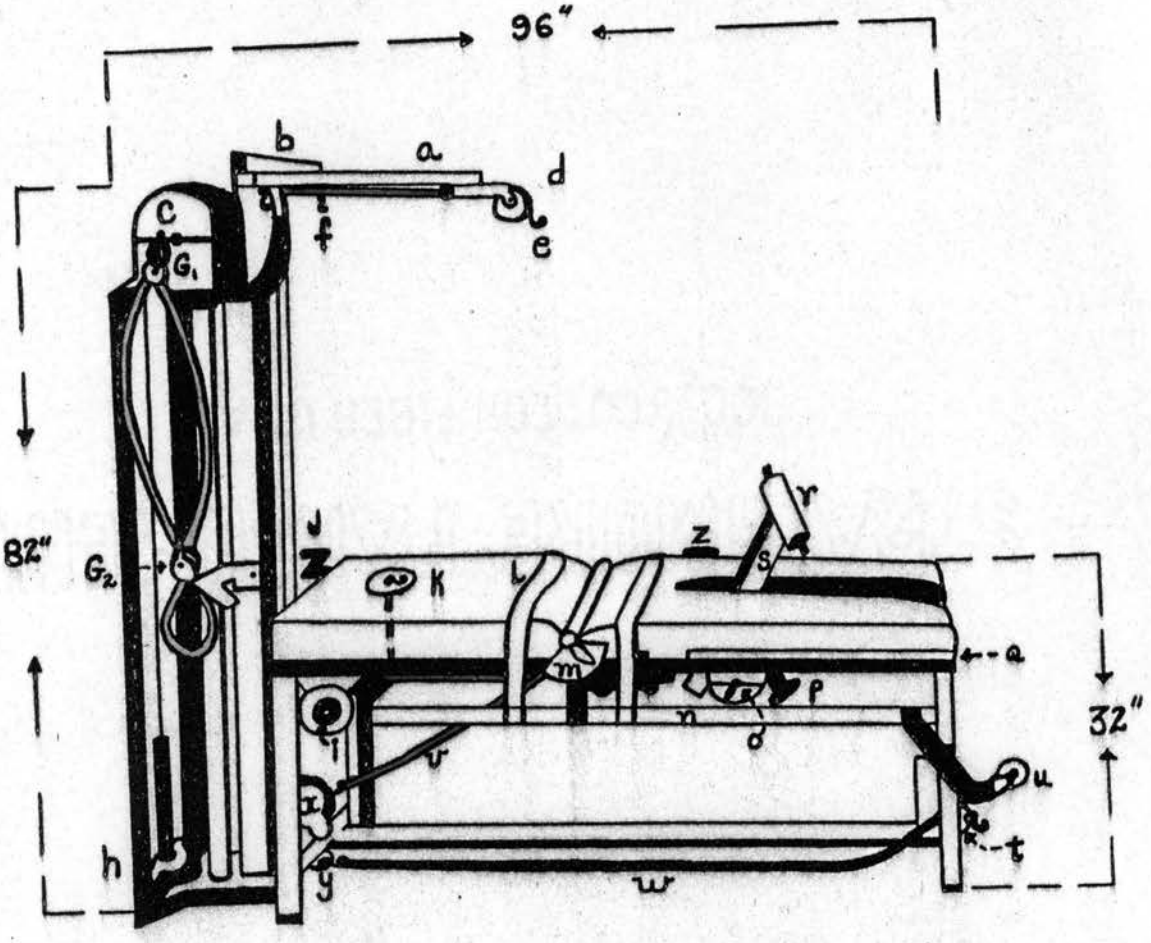

Figure 1. Complete Exercise Unit

Description of the Table

The Elgin Exercise Unit Model A 1500 is essentially a steel framed table with an attached weight pan assembly. The complete unit is 8 feet long, 32 inches wide, and 34 inches high. The table frame is constructed of 1 5/8 inches cold-rolled, chrome-plated square tubular steel. The table is upholstered in a sturdy brown plastic, over a thick, rubbery padding (46:2).

The complete exercise unit for administering Progressive Resistance Exercise is shown in Figure 1. To facilitate understanding and for later referral, the various assemblies have been labeled. A brief description of each assembly follows:

(a) The track upon which the overhead pulley (d) operates. This track is adjustable and can be moved closer to the housing (c) or extended out approximately two feet toward the opposite end of the table by loosening the knob near the pulley attachment and sliding it to the desired position. The desirable position for the track and pulley will depend upon the exercise to be administered. Once it is properly adjusted into position, it should be locked into place utilizing the knob on the track.

(b) Stationary bar onto which the adjustable suspension cables are attached.

(c) Housing for the pulleys common to all cables. Within the housing is the common linking of all cables to the weight pan.

(d) Overhead pulley. This pulley is utilized for all load-assisting or load-resisting exercises in which the pull is best applied from above the table.

(e) Snap buckle utilized to attach the subject to the cable and

thereby to the weight pan assembly.

(f) Suspension cables. These cables are made of nylon cord and utilized primarily in conjunction with the ankle cuffs to hold the legs at a constant height for load-assisting or load-resisting hip abductor and hip adductor exercises. The position of the cables is adjustable since they may be slid along the stationary bar. To accomplish this, the black knob on the stationary bar is loosened, allowing the suspension cable assembly to be moved to the desired position by sliding it along the track. When the desired position is determined, the cables should be locked into place utilizing the same knob. These cables, when not in use, are wrapped around the stationary bar (b). The height at which the legs are to be held by the suspension cables can be adjusted by wrapping the cord around the stationary bar the desired number of times to result in the proper height.

(g) Hip abductor assembly. This pulley (G_2) is moved into a position above the table by removing G_1 from the hook and swinging it forward to attach to the cable clamp on the overhead pulley (d). G_2 is then locked into position above the table top by screwing the bolt provided into the sprocket hole in the frame of the assembly. When not in use, it should be swung into a position at the side of the unit. This pulley assembly, as well as the suspension cables and ankle cuffs, are used in bilateral or unilateral hip abduction exercises. They can be further utilized in various exercises to strengthen the knees and ankles.

(h) Weight pan common to all pulleys.

(i) Wheel for adjusting excursion of the boot carriage (r). This wheel controls the distance over which the carriage will travel during

an exercise by controlling the distance through which the weight pan travels. The higher the weight pan from the base of the unit, the smaller the distance the carriage will travel. The degree of excursion desired would vary with the exercise performed.

(j) Handle for adjusting the height of the backrest. At the fore-end of this handle is a knob which must be loosened before the backrest can be raised. Once loosened, the handle is turned clockwise to raise the level of the backrest to the desired angle. Upon reaching the desired backrest angle, the knob must be tightened in order to make this position stationary.

(k) Table top pulley. This pulley is utilized when the exercise to be performed is best resisted from below the table. The table top pulley passes through the table's top and follows a pattern parallel to the backrest. At the junction of the backrest and the leg rest, the cable passes over a directional pulley. When not in use, the snap buckle is attached to the stationary hole (y) in the lower frame. If the table top pulley is to be utilized, the cable snap buckle is removed from (y) and attached to the common weight pan pulley (x) for all cables below the table's top. The desired amount of weight is placed on the weight pan, and the table top pulley is attached to the subject.

(l) Stabilizing straps. These two web straps help localize the exercise load, eliminate muscle substitution, prevent strain, and make the subject's position secure. Variations in strapping depend on the exercise being performed.

(m) The scale indicating the angle of the backrest. This scale is actually a protractor indicating the angulation of the backrest on the

table.

(n) Stationary bar to which the stabilizing straps may be attached.

(O) Dial indicating the angle of the boot carriage (r).

(p) Handle to adjust the boot carriage angle. The desired angle depends upon the exercise being performed.

(q) A linear scale for indicating the excursion of the boot carriage (r).

(r) The boot carriage to which the "boots" may be attached when performing certain lower extremity exercises or for securing the lower extremities when performing trunk exercises. The carriage simply fits into the rectangular slot provided under the leg rest portion of the table. When the desired height of the boot carriage is determined, the carriage can be moved into position by utilizing the knob (z) at the side of the table. When not in use, this carriage may be removed.

The resistance which can be applied in the exercises involving the boot carriage is determined by the amount of weight placed on the weight pan since the boot carriage assembly is directly attached to the pan assembly. Extreme caution should be used in utilizing this boot carriage because of the tension developed in the cables when the carriage is moved through the excursion area. The tension will cause the boot carriage to quickly and forcibly return to its initial position if muscular effort is not maintained throughout the entire exercise.

(s) Calibrations on the boot carriage (r).

(t) Special pulley assembly: quadriceps pulley. This pulley assembly is used chiefly in knee, elbow, and trunk extension exercises. It may be positioned anywhere along the metal bar upon which it is mounted. The cable, associated with this pulley assembly, is attached

to the hole (y) in the stationary frame when not in use. To utilize the pulley assembly, the cable snap buckle is removed from (y) and attached to the pulley assembly system (x). The desired amount of weight is placed on the weight pan, and the snap buckle is attached to the subject.

(u) Attachments for hip rotator exercises. These attachments require the threading of an alternate cable through the associated pulley (u). This supplementary cable is an extra cable and is not actually a part of the table. The threading is done by taking the permanent looped end of a supplementary cable and threading it through the assembly. Upon completion of this phase, the cable's loop may be attached to either the overhead pulley (d) or the lower common weight pan pulley assembly (x).

This attachment is utilized primarily for hip rotator exercises as well as for the rotators of the neck and flexors and extensors of the wrist. When not in use, the cable from this assembly is attached to the permanent hole in the lower frame (y).

(v) Cable from the table top pulley. This cable, in the diagram, is attached to the common weight pan pulley below the table (x). When the cable is in this position, the table top pulley assembly is ready for use.

(w) Cable from the special pulley assembly (t) to the hole (y) in the stationary frame for cables not in use. When the cable is in this position, the special pulley assembly is not in use.

(x) Common weight pan pulley for all cables below the table.

(y) Hole in the lower frame for attachment of cables which are not in use.

(z) Knob for adjustment of the height of the boot carriage. This knob locks the carriage into place after the desired height has been determined. When the knob is loosened, the carriage may be removed from its position in the table's top.

In addition to the actual Elgin Exercise Table, there are certain attachments needed to facilitate the administration of a complete program of progressive resistance exercise utilizing the unit. The following pieces of equipment are necessary adjuncts to the administration of a complete exercise program on the Elgin Exercise Table.

Necessary and Important Attachments

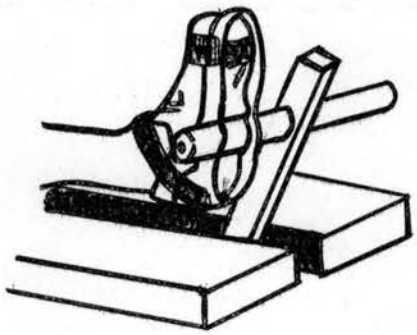

Figure 2. Boot Assembly

Boot Assembly

The boot assembly is ideal for quadriceps and various other exercises for the knee and ankle in which the resistance is applied by the table's pulley arrangement or weights attached directly to the boot.

The assembly usually includes an aluminum bar, one boot, and two locking collars. This basic assembly provides adequate equipment for unilateral exercises. If bilateral exercises were to be administered, two such assemblies would be necessary.

The aluminum bars come in various lengths, ranging from 12 inches to 4 feet; however, the length commonly included in the assembly is the 18-inch bar. The two locking collars are utilized to secure the weights to the bar, or the boot to the boot carriage. The collar is simply slipped into place on either the aluminum bar or the table's boot carriage. To release the collar, the clip on the surface of the collar is pushed down as the collar is removed from the bar.

The special quadriceps boot is constructed of sturdy, light weight aluminum. Since the boot is not adjustable, it is suggested that both an adult and a child's boot be obtained. In fact, it would be best if a pair of each size were available so that bilateral exercises could be performed.

This boot assembly is ideal for utilization in connection with the table's boot carriage. In this instance, the boot is directly attached to the carriage by sliding the extension of the carriage into the circular slot provided on the bottom of the boot. Once the boots are placed on the carriage, the collars are utilized to lock the boots into position. The boots are then attached to the shoe of the subject by the two straps provided at the heel and the toe of the boot.

Since the boot carriage has a direct cable attachment to the common weight pan pulley assembly (c), the resistance to the exercise utilizing this arrangement is provided by the weights placed on the weight pan. In addition, this boot assembly may be utilized by running a cable from

one of the pulley arrangements through the circular slot in the bottom of the boot and attaching the snap buckle around the cable itself. This arrangement provides possibilities for exercising the hip in movements of flexion, extension, abduction, and knee extension.

The boot assembly may also be used for exercises not utilizing the pulley arrangement of the table. In this instance, the aluminum bar is employed instead of the table's boot carriage. The appropriate weights are attached directly to the bar and positioned close to the boot. When the weights are in their proper place, they are locked into position by the locking collars.

Special Drilled Aluminum Boot

This is a sturdy, light weight, aluminum boot designed for use in quadriceps exercises in conjunction with any pulley arrangement of the table, or the boot assembly. The boot is drilled so that the cable snap buckle can be fastened directly to the toe of the boot for selected exercises. In addition, the circular slot is provided on the bottom of the boot for attachment to the carriage or the aluminum bar and weights in the boot assembly.

Like the others, the drilled aluminum boot is not adjustable in size but adult and child-sized boots are available.

Foot Drop Boot

The boot is designed with an aluminum extension projecting upward from the heel of the boot. Three straps are provided for attachment to the subject. The lower straps are attached as in the other boot assemblies. The third strap, at the top of the extension, is strapped

securely to the subject's leg.

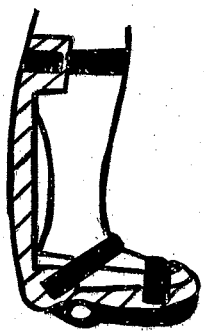

Figure 3. Foot Drop Boot

The "foot-drop boot" is good for quadriceps exercises when the subject's ankle is weak. The boot immobilizes the ankle and relieves the ankle strain which might occur during the exercise, allowing a more effective job of exercising the desired muscle.

This boot may be utilized in conjunction with the boot assembly bar and weights and the carriage of the table, as well as with the various pulley assemblies of the table. In the latter instance, the cable snap buckle is attached to the holes at the toe of the boot or threaded through the circular slot on the bottom of the boot as previously described.

Like the others, the foot drop boot is not adjustable in size, but adult and child sized boots are available.

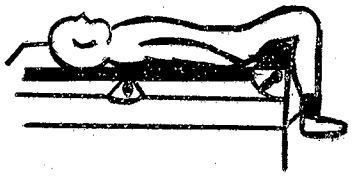

Figure 4. Pelvic Rest

Pelvic Rest

The pelvic rest is 8 1/2 inches high and 13 1/8 inches long. It is constructed of a rigid aluminum base and upholstered in a sturdy, brown, plastic over a foam rubber padding. It is utilized to allow a greater range of movement during the exercise by raising the subject's exercising body part off the table. In addition, it is used to relieve pressure and discomfort in the pelvic girdle during certain resistance exercises.

Thigh (Quadriceps) Rest

The quadriceps rest is approximately 3 inches high, 7 inches wide, and 13 inches long. It is similar to the pelvic rest and utilized for the same purposes. In addition, it is used with the table or ankle and foot exerciser.

Shoulder Harness

This harness is designed for use in abdominal and back exercises in conjunction with the pulley arrangements on the Elgin Table, or the small weight pan assembly. It is constructed of leather and available in three sizes.

For abdominal exercises, the shoulder harness is placed on the

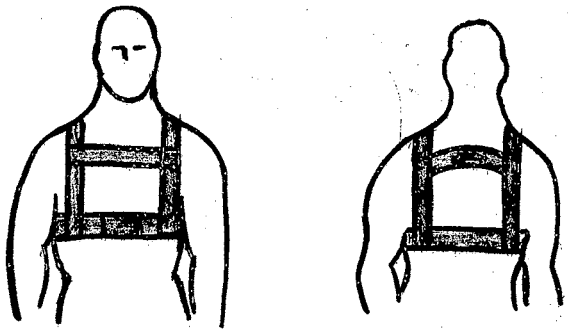

Figure 5. Shoulder Harness

subject so that the metal projection is positioned on the subject's back. To accomplish this, all the straps are loosened to provide ample room for fitting it to the subject. The shoulder strap is then slipped over the subject's upper body into a position as shown in the diagram. Once on the subject, the straps are tightened so that the harness fits snugly. The cable snap buckle from the various pulley arrangements are attached directly to the metal projection. In addition, the small weight pan may be utilized by attaching the snap to the projection. For back exercises, the harness is simply reversed.

Head Harness

The head gear is constructed of adjustable web strapping and is designed for utilization in either assistive or resistive neck exercises.

The adjustable head gear is comprised of three straps: a horizontal strap around the head, a chin strap, and a strap that passes over the head in the sagittal plane. In addition, the head harness is equipped with four D-rings: a ring on the right and left side of the head, a ring on the front, and a ring on the back of the head.

The harness should fit snugly so that it will not rub against the skin. After the head harness has been securely attached, the snap buckle from a table pulley or the small weight pan can be snapped onto the desirable D-ring on the harness.

Foot Stirrup

This adjustable leather foot stirrup is designed for use in either load-assisting or load-resisting exercises of the hip, knee, or ankle.

The foot stirrup fits over the subject's shoe. One strap goes from the back of the heel to the front, while the other strap fits over and under the instep of the foot.

Resistance can be applied by attaching the table's pulley assembly or the small weight pan to the appropriate D-ring on the stirrup.

Thigh Cuff

This is a leather cuff for use in hip exercises where the knee or ankle is weak. It allows the resistance to be applied directly at the thigh, eliminating the long body lever necessary when the cable is attached at the ankle.

The cuff is 3 inches wide, 24 inches long, and adjusts from 18 to 24 inches. It is constructed of steer hide and lined with soft, pliable, non-irritating pigskin.

The thigh cuff can be attached directly to a weight pan or pulley system by means of a D-ring.

Wrist Cuff

This leather cuff is useful for assisted or resisted exercises

where it is desired to apply the resistance directly to the wrist. The cuff is 3 inches wide, 10 inches long, and adjusts from 7 to 10 inches. The means of resistance and its attachment are the same as for the thigh cuff.

Ankle Cuff

This cuff is designed for assisted or resisted exercises in which it is desired to apply resistance directly to the ankle. In addition, this cuff is utilized in conjunction with the suspension cables in hip abduction exercises to affix the legs at a constant exercise height.

The cuff is 3 inches wide, 16 inches long, and adjusts from 11 to 16 inches. The D-ring provides the means of attaching the snap from the weight pan or the table's pulley assembly.

Metal Stirrup Handle

This aluminum stirrup handle is utilized in shoulder and arm exercises and may be attached to any pulley arrangement by means of the cable snap buckle.

Pronator-Supinator Attachment

This attachment is designed for exercising the pronators and supinators of the hand and forearm. The complete attachment includes an aluminum wheel and a bar.

The bar fits into the same table slot as that for the boot carriage (r). The angle and height of the bar is adjusted in the same manner as was described for the boot carriage. The wheel is supplied with a 4-foot cable, one end of which is permanently attached to the

wheel. The other loop is designed to be attached to the overhead pulley assembly.

If a permanent cable is not attached, one end of an alternate cable can be snapped to the permanent extension of the wheel, while the other end is attached to the snap buckle on the overhead pulley.

Available Accessories

Dumbbell Assembly

The dumbbell assembly is useful in arm and shoulder exercises; however, it is not used in connection with the table. The usual assembly includes one bar, one handle, and two locking collars.

The bar is constructed of aluminum and is available in five sizes ranging from 12 inches to 48 inches. The weights are the same as those used on the table.

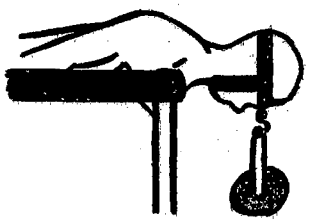

Figure 6. Small Weight Pan

Small Weight Pan

This is a strong, light weight pan used in conjunction with the head strap, shoulder harnesses, thigh cuff, wrist and ankle cuffs,

and the aluminum boots. It attaches directly to the D-rings on the various straps.

Back Weight Pan

This weight pan is suitable for placing weight on a subject's back or chest for trunk hyperextension and flexion exercises. The weight pan has a light weight aluminum base covered with leather. The weight pan is attached to the subject's back by placing the adjustable straps over the shoulders so that the two straps intersect about midway on the sternum. The third strap goes around the subject's chest about one to one and a half inches below the nipples and slips through the stationary loops on the shoulder straps. When the straps are in the proper position, they should be secured utilizing the buckles on each strap. These procedures are reversed if it is desired to place the weight pan on the subject's chest. The desired weight can be slipped onto the spindle to provide the resistance.

Shoulder Weight Bag

This piece of equipment is useful because it eliminates the necessity of holding weights in the hands.

The apparatus can be utilized for shoulder exercises when there is a weakness of the shoulder, shoulder joint, forearm or hand. An advantage of this apparatus is the fact that the weights can be evenly distributed between the front and back.

Ankle and Leg Exerciser

This all aluminum Elgin unit is designed to exercise the foot and

leg through a full range of motion in inversion, eversion, dorsi-flexion and plantar-flexion. Since these exercises can be performed on the table utilizing the various boot assemblies, it is not essential to purchase this piece of equipment in order to provide a complete exercise program.

The unit is composed of an aluminum boot and four weight pans. These weight pans are positioned at the toe, the heel, the right, and the left of the boot. Graded resistance to the desired movement is made possible by adding selected weights to the appropriate weight pan.

For the exercises of plantar-flexion and dorsi-flexion, the unit may be locked into place utilizing the lever under the boot assembly. Locked into position, the boot will move only in the sagittal plane. The assembly may also be locked into position to permit only inversion and eversion, if desired. To properly operate the apparatus, the directions in the manual accompanying the unit should be followed.

Conclusions

As can be seen from the preceding descriptions, the Elgin Exercise Table is a very versatile machine--if one knows how to utilize it to its fullest potential.

It is hoped that this chapter has acquainted the reader with the mechanics of the table's operation and laid the groundwork needed for administering the exercises suggested in the next chapter.

CHAPTER V

EXERCISES FOR STRENGTH DEVELOPMENT

Seventy-six original exercises have been devised through experimentation with subjects and through anatomical and kinesiological analyses. Two exercises for each joint action were selected on the bases of the fourteen criteria presented on pages eight through thirteen.

The exercises have been presented in terms of movements of the various joints in the body. Each exercise is uniformly presented in four sections: the table set-up, the positioning of the subject, the performance of the exercise, and a pictorial diagram of the subject and the table. Various exercises are accompanied by notes to the administrator as to the exercise range, the part(s) which must be maintained in a constant position throughout the exercise, and movements to be avoided.

Neck Flexor Exercises

I. Neck Flexor Exercise: Supine

Table: Initial to the exercise, the special pulley assembly (t) is attached to the common weight pan pulley below the table (x) as previously described on page 50. The appropriate weights are selected and placed on the weight pan.

Subject: After the head harness is firmly attached, the subject assumes a supine position on the table with the shoulders parallel to the end and the head and neck extended out from the foot-end of the

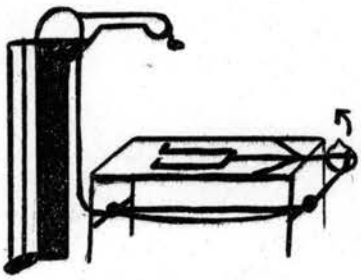

Figure 7

table. The hands may grasp the sides of the table for support. The cable snap buckle from the special pulley assembly is attached to the D-ring provided at the back of the head harness. Stabilization may be necessary, especially with augmented exercise loads. If needed, the straps should be placed according to the individual needs of the subject performing the exercise.

Exercise: The exercise is performed by flexing the neck against the resistance provided by the table's pulley arrangement. As strength develops, the resistance to the exercise should be increased by the addition of weights to the weight pan.

II. Neck Flexor Exercise: Sitting

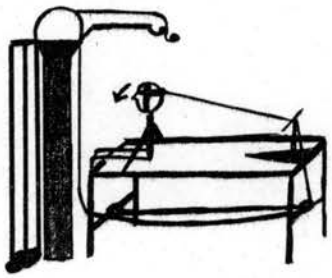

Figure 8

Table: The special pulley arrangement, pronator bar, and the directional pulley wheel are attached for utilization as described on page 50. The desired angle of the bar should be 90 degrees, while the height of the bar will be dependent on the individual needs of the subject. The bar should be positioned 10 inches from the foot end of the table and stabilized there by utilizing the boot straps.

These straps may be placed around the table's frame and the rod extending out from the boot carriage assembly below the table. A supplementary cable is attached to the snap buckle of the special pulley assembly, passed through the boot carriage excursion area in the table top and over the directional pulley wheel on the bar. The appropriate weight is added to the weight pan.

Subject: After the head harness is firmly attached, the subject assumes a sitting position on the table facing the weight pan and 1 1/2 feet back from the head-end of the table. The hands are placed on the sides of the table top for support. The snap buckle from the cable is attached to the D-ring on the back of the head harness.

Exercise: The subject performs the exercise by flexing the neck against the resistance offered by the table's pulley arrangement.

Note: During the exercise, the subject should be instructed to mobilize only the neck and not the upper trunk. If substitution is made, an alternate exercise arrangement which reduces substitution to a minimum is suggested.

Neck Hyperextensor Exercises

I. Neck Hyperextensor Exercise: Prone

Table: Initial to the exercise, the special pulley assembly (t) is attached for utilization as described on page 50. The appropriate weight is selected and placed on the weight pan.

Subject: After the head harness is firmly attached, the subject assumes a prone position on the table with shoulders parallel to the end of the table and head and neck flexed over the foot-end. The hands grasp the sides of the table near the shoulders for support. The cable

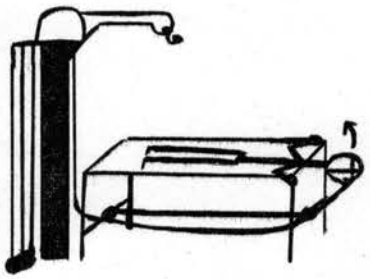

Figure 9

snap buckle from the special pulley assembly is attached to the D-ring provided at the front of the head harness. Stabilization may be necessary, especially with augmented exercise loads. If needed, the strap should be placed approximately two inches below the shoulder joint.

Exercise: The exercise is performed by hyperextending the neck against the resistance provided by the table's pulley arrangement. As the strength increases, the resistance to the exercise should be increased by the addition of weights to the weight pan.

II. Neck Hyperextensor Exercise: Sitting

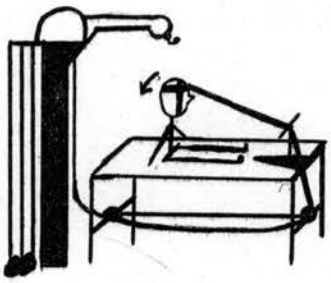

Figure 10

Table: The special pulley arrangement, pronator bar, and the directional pulley wheel are attached for utilization as described on pages 50 and 58. The angle of the bar should be 90 degrees while the height of the bar will be dependent upon the individual needs of the subject. The bar should be positioned 10 inches from the foot-end of the table and stabilized there by utilizing the boot straps as previously described. A supplementary cable is attached to the snap buckle of the special pulley assembly, passed through the boot carriage

excursion area in the table top and over the directional pulley wheel on the bar. The appropriate weight is added to the weight pan.

Subject: After the head harness is firmly attached, the subject assumes a long sitting position on the table facing the bar 1 1/2 feet from the head-end. The legs are placed on either side of the bar, and the hands are placed on the sides of the table top for support. The snap buckle from the cable is attached to the D-ring on the front of the head harness.

Exercise: The exercise is performed by hyperextending the neck against the resistance offered by the table's pulley arrangement.

Note: During the exercise, the subject should be instructed to mobilize only the neck and not the upper trunk. If substitution is made, an alternate exercise arrangement which reduces substitution to a minimum is suggested.

Neck Lateral Flexor Exercises

I. Neck Lateral Flexor Exercise: Side-Lying

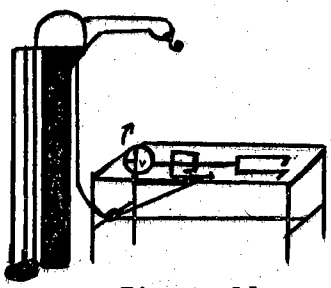

Figure 11

Table: The table top pulley is adjusted for operation as described on page 48. The appropriate weight is selected and placed on the weight pan.

Subject: The head harness is snugly attached to the subject's head as previously described. The subject assumes a side-lying position with the head directly

over the table top pulley. The arm on top may be utilized to provide support. The same procedures for stabilization and reduction of substitution utilized in the preceding exercise patterns may be employed. Initial to the exercise, the table top pulley's snap buckle is attached to the D-ring on the side of the head harness.

Exercise: The exercise is performed by laterally flexing the neck against the resistance offered by the table's pulley arrangement. As strength increases, the resistance to the exercise should be increased.

Note: This exercise arrangement provides a lateral flexion exercise for only one side of the neck. To exercise the lateral flexors of the opposite side, instruct the subject to lie on his opposite side.

II. Neck Lateral Flexor Exercise: Sitting

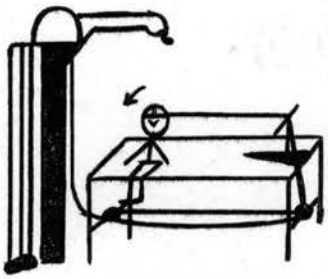

Figure 12

Table: The special pulley assembly, pronator bar, and the directional pulley wheel are attached for operation as previously described on pages 50 and 58. The angle of the bar should be 90 degrees while the height will be dependent upon the subject to be exercised. The bar should be positioned 10 inches from the foot-end of the table and stabilized in place by utilizing the boot straps as previously described. A supplementary cable is attached to the snap buckle of the special pulley assembly, passed through the boot carriage excursion area in the table top and over the directional pulley wheel on the bar. The

appropriate weight is added to the weight pan.

Subject: After the head harness is firmly affixed, the subject assumes an erect sitting position on the side of the table 1 1/2 feet from the head-end, with the lateral flexors to be exercised adjacent to the bar. The hands are placed on the table top for support. The snap buckle from the supplementary cable is attached to the D-ring on the side of the head harness closest to the bar.

Exercise: The exercise is performed by laterally flexing the neck against the resistance offered by the table's pulley arrangement.

Note: The subject is instructed to mobilize only the neck and not the upper trunk. If unnecessary substitution is observed, it is suggested that one utilize one of the other exercise arrangements where substitution is more easily reduced. To exercise the other set of lateral neck flexors, the subject should sit facing the other side of the table.

Neck Rotator Exercises

I. Neck Rotator Exercise: Prone

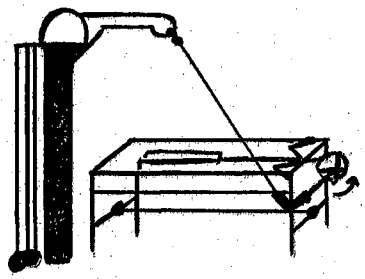

Figure 13

Table: The hip rotator attachments are threaded with the supplementary cable and attached for operation as previously described on page 50. Upon completion of the threading, the supplementary cable is attached to the snap buckle of the overhead pulley. The appropriate weights are selected and placed on

the weight pan.

Subject: After the head harness has been firmly attached, the subject assumes a prone position on the table with his shoulders parallel to the end of the table and head and neck extended out from the foot-end of the table. The hands grasp the sides of the table near the shoulders. Stabilization may be attained by a strap positioned at shoulder height. The cable snap buckle is attached to the appropriate D-ring on the side of the head harness.

Exercise: The exercise is performed by rotating the head away from the attachment against the resistance provided by the table's pulley arrangement. As strength increases, the resistance to the exercise should be increased.

Note: This arrangement exercises the rotators on one side of the neck. To exercise those on the opposite side, follow the same procedures utilizing the hip rotator attachment on the other side of the table.

II. Neck Rotator Exercise: Sitting

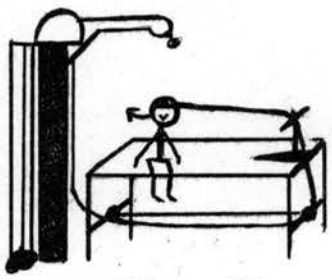

Figure 14

Table: The special pulley arrangement, pronator bar, and directional pulley wheel are attached for operation as described on page 50. The desired height of the bar is determined by the individual needs of the subject. The angle of the bar should be 90 degrees. The bar should be positioned 10 inches from the foot-end and stabilized

in place by utilizing the boot straps as previously described. The supplementary cable is attached to the snap buckle of the special pulley assembly, passed through the boot carriage excursion area in the table top and over the directional pulley wheel on the bar. The appropriate weight should be added to the weight pan.

Subject: After the head harness is attached, the subject assumes a sitting position on the side of the table 1 1/2 feet from the head-end, with rotators to be exercised nearest the bar. The hands are placed on the table top for support. The snap buckle from the supplementary cable is attached to the D-ring on the side of the head harness closest to the bar.

Exercise: The exercise is performed by rotating the neck against the resistance offered by the table's pulley arrangement.

Note: The subject is instructed to mobilize only the neck and not the upper trunk. If substitution occurs, it is suggested that one utilize another exercise arrangement where substitution is more easily reduced. The arrangement described above is a unilateral exercise. To strengthen muscles on the other side, have the subject face the opposite direction and follow the preceding instructions.

Wrist Hyperextensor Exercises

I. Wrist Hyperextensor Exercise: Prone

Table: The special pulley assembly is attached for operation as described on page 50. A metal handle is hooked to the snap buckle of the pulley assembly. The appropriate weights should be placed on the weight pan.

Subject: The subject assumes a prone position on the table with

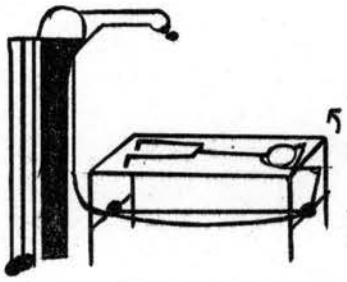

Figure 15

the wrist to be exercised, pronated, and extended past the foot-end of the table approximately 1 to 1 1/2 inches. Stabilization and reduction of substitution may be accomplished by utilizing the free arm or stabilizing straps. If stabilizing straps are utilized, they should be positioned approximately 3 inches from the wrist. If the free hand and arm are used, it, too, should be placed across the forearm approximately 3 inches from the wrist to be exercised. Prior to the exercise, the metal handle is placed in the subject's hand.

Exercise: The exercise is performed by hyperextending the wrist against the resistance offered by the table's pulley arrangement.

II. Wrist Hyperextensor Exercise: Sitting

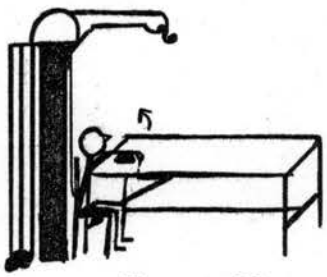

Figure 16

Table: The table top pulley is attached for operation as previously described in Chapter IV, page 48. The metal handle is hooked to the snap buckle of the table top pulley and the appropriate weights are placed on the weight pan.

Subject: The subject is seated in a chair near the headrest on the table facing the foot-end. The wrist to be exercised is

pronated and rested across one of the padded sides of the pelvic (or thigh) rest approximately 1 to 1 1/2 inches. The distal end of the forearm is stabilized by utilizing a table strap. Prior to the exercise, the metal handle is placed in the slightly flexed, pronated hand.

Exercise: The exercise is performed by hyperextending the wrist against the resistance offered by the table's pulley arrangement.

Wrist Flexor Exercises

I. Wrist Flexor Exercise: Prone

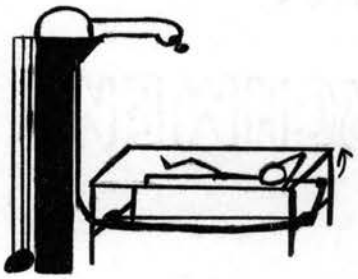

Figure 17

Table: The special pulley assembly is attached for operation as previously described on page 50. The metal handle is hooked to the snap buckle of the pulley arrangement. The appropriate weights are placed on the weight pan.

Subject: The subject assumes a prone position on the table. The wrist to be exercised is supinated and extended past the foot-end of the table approximately 1 to 1 1/2 inches. In order to be able to rest the entire supinated forearm on the table top, it may be necessary to roll the body slightly toward the side being exercised. To reduce substitution by other muscle groups, it may be necessary to stabilize the forearm by utilizing a table strap. The metal handle is placed in the subject's hand.

Exercise: To perform the exercise, the subject flexes the wrist against the resistance offered by the table's pulley arrangement.

II. Wrist Flexor Exercise: Standing

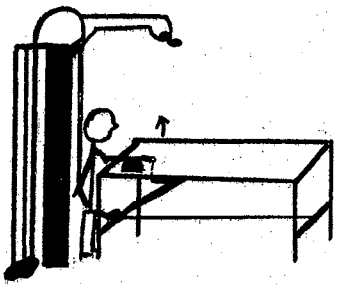

Figure 18

Table: The table top pulley is attached for operation as described on page 48. The metal handle is hooked to the snap buckle of the table top pulley. The appropriate weight is selected and placed on the weight pan.

Subject: The subject assumes an erect standing position behind, to one side, and facing the head-end of the table. The wrist to be exercised is supinated and extended across one of the padded sides of the pelvic (or thigh) rest approximately 1 to 1 1/2 inches. The distal end of the forearm is stabilized by utilizing a table strap. The metal handle is placed in the slightly extended, supinated hand.

Exercise: The exercise is performed by flexing the wrist against the resistance offered by the table's pulley arrangement.

Wrist Radial Flexor Exercises

I. Wrist Radial Flexor Exercise: Prone

Table: The hip rotator assembly is attached for operation as previously described in Chapter IV, page 50. The wrist cuff is attached to the cable by utilizing the snap buckle. The resistance is applied by placing the appropriate weight on the weight pan.

Subject: The subject assumes a prone position on the table top

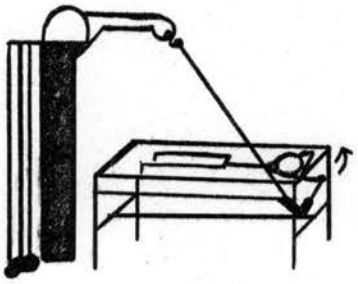

Figure 19

with the wrist to be exercised semi-pronated, supinated, and extended 1 to 1 1/2 inches off the foot-end of the table. The forearm is stabilized utilizing a table strap. When the proper position is attained, the wrist cuff from the pulley assembly closest to the exercising wrist is securely fastened to the subject's hand.

Exercise: The exercise is performed by radially flexing the wrist against the resistance provided by the table's pulley arrangement.

II. Wrist Radial Flexor Exercise: Sitting

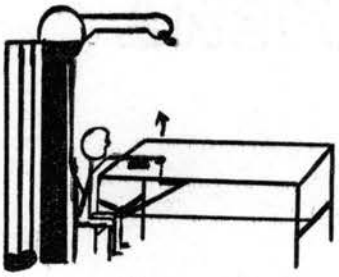

Figure 20

Table: The table top pulley is attached for operation as described in Chapter IV, page 48. The wrist cuff is attached to the snap buckle on the table top pulley. The appropriate weight is selected and attached to the weight pan.

Subject: The subject is seated in a chair at the end of the head-rest and facing the foot of the table. The wrist to be exercised is semi-pronated, supinated. The wrist is placed across one of the padded sides of the pelvic (or thigh) rest approximately 1 to 1 1/2 inches. The distal end of the forearm is stabilized by utilizing the table strap. The wrist cuff is securely

attached to the hand of the subject.

Exercise: The exercise is performed by utilizing the radial flexors to move the thumb, medially, closer to the radius.

Wrist Ulnar Flexor Exercises

I. Wrist Ulnar Flexor Exercise: Sitting

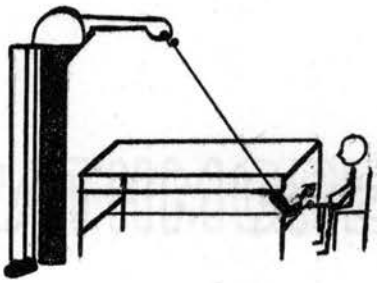

Figure 21

Table: The hip rotator assembly is attached for operation as previously described in Chapter IV, page 50. The wrist cuff is attached to the cable by utilizing the snap buckle. The resistance is applied by placing the appropriate weight on the weight pan.

Subject: The subject assumes a seated position close to and facing the foot-end of the table. The upper two-thirds of the forearm is placed on the subject's thigh. The wrist and hand are supinated. The free hand is placed on the forearm of the exercising wrist to add stability and reduce substitution. The wrist cuff from the pulley arrangement closest to the wrist to be exercised is placed securely on the hand.

Exercise: To perform the exercise, the subject utilizes his ulnar flexors to move the wrist medially.

II. Wrist Ulnar Flexor Exercise: Prone

Table: The table arrangement and set-up is the same as in the

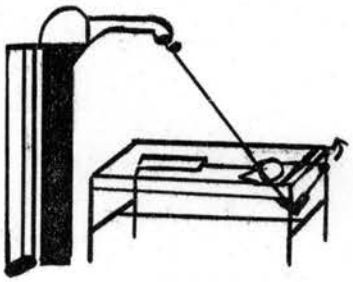

Figure 22

preceding exercise arrangement (Figure 21).

Subject: The subject assumes a prone position on the table top with the wrist to be exercised pronated and extended 1 to 1 1/2 inches off the foot-end of the table. The forearm is stabilized utilizing a table strap. When the proper position is attained, the cuff from the pulley assembly fartherest from the exercising wrist is securely fastened to the subject's hand.

Exercise: To perform the exercise, the subject utilizes the ulnar flexors to move the wrist laterally.

Wrist Supinator Exercises

I. Wrist Supinator Exercise: Standing

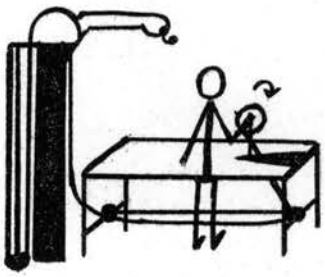

Figure 23

Table: The pronator bar and wheel are attached and secured in place according to the procedures on page 58. The angle of the bar should be 90 degrees, while the height of the bar will be dependent upon the individual performing the exercise arrangement. The wheel cable is attached to the special pulley assembly by utilizing the snap buckle. The wheel cable should be wrapped around the wheel so

that clockwise resisted movement is possible.

Subject: The subject assumes an erect standing position at the side of the table opposite the bar and wheel assembly. The subject grasps the wheel at the handle with elbow flexed and wrist slightly pronated. The subject should be instructed to keep the forearm at a constant position to avoid shoulder substitution.

Exercise: To perform the exercise, the subject grasping the handle supinates the wrist and forearm by turning the wheel clockwise. The clockwise movement is resisted by the table's pulley arrangement.

II. Wrist Supinator Exercise: Sitting

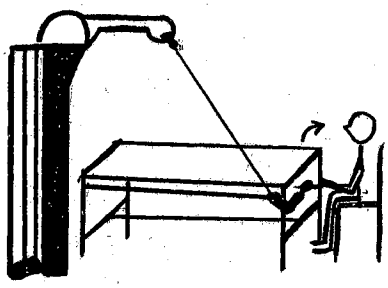

Figure 24

Table: The hip rotator assembly is adjusted and attached for operation as previously described in Chapter IV, page 50. The wrist cuff is attached to the cable by utilizing the snap buckle. The resistance is applied by placing the appropriate weight on the weight pan.

Subject: The subject assumes a seated position at the end of the table. The upper two-thirds of the forearm is placed on the subject's thigh. The wrist and hand are slightly pronated. The free hand is placed on the lateral side of the forearm in such a way as to prevent lateral rotation of the shoulder without hampering supination. The wrist cuff from the fartherest hip rotator pulley arrangement is securely attached to the exercising wrist.

Exercise: To perform the exercise, the subject supinates the wrist against the resistance offered by the table's pulley arrangement.

Wrist Pronator Exercises

I. Wrist Pronator Exercise: Standing

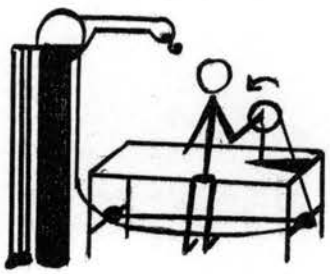

Figure 25

Table: The bar and wheel are attached and adjusted into position as described on page 58. The angle of the bar should be 90 degrees, while the height of the bar will be dependent upon the individual performing the exercise pattern. The wheel cable is attached to the special pulley assembly by utilizing the snap buckle. The cable should be wrapped around the wheel so that counterclockwise resisted movement is possible.

Subject: The subject assumes an erect standing position at the side of the table opposite the bar and wheel. The subject grasps the wheel at the handle with elbow flexed and wrist slightly supinated. The subject should be instructed to keep the forearm at a constant position to avoid shoulder substitution.

Exercise: To perform the exercise, the subject grasps the handle and pronates the wrist by turning the wheel counterclockwise against the resistance offered by the table's pulley arrangement.

II. Wrist Pronator Exercise: Sitting

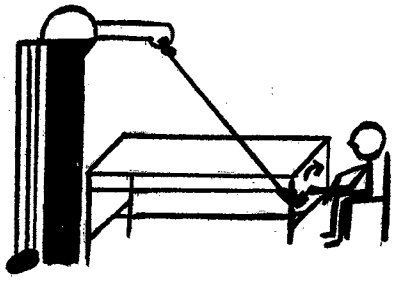

Figure 26

Table: The hip rotator assembly is adjusted for operation as previously described on page 50. The wrist cuff is attached to the cable by utilizing the snap buckle. The resistance is applied by the placement of the appropriate weights on the weight pan.

Subject: The subject assumes a seated position close to and facing the foot-end of the table. The upper two-thirds of the forearm is placed on the thigh. The wrist and hand are in a slightly supinated position. The free hand is placed on the forearm of the wrist to be exercised to add stability and reduce substitution but should not grasp the arm so tightly as to interfere with pronation. The wrist cuff attached to the pulley assembly closest to the exercising wrist is firmly secured to the wrist.

Exercise: To perform the exercise, the subject pronates the hand against the resistance provided by the table's pulley arrangement.

Elbow Flexor Exercises

I. Elbow Flexor Exercise: Sitting

Table: The special pulley assembly is attached for operation as outlined on page 50. The overhead pulley is adjusted to a position directly over the subject's chest. A supplementary cable is attached

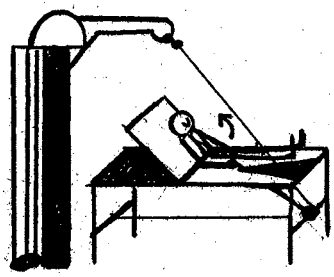

Figure 27

to the snap buckle of the overhead pulley. The cable is then passed through the boot carriage excursion area in the table top clockwise (as the operator faces it) around the lower pulley assembly and back up through the excursion area. The metal handle is attached to this end of the cable by utilizing the snap buckle. The appropriate weight is added to the weight pan. The backrest should be raised according to the procedures outlined in Chapter IV, page 51. The desired height will be dependent upon the range of motion desired. A 45-degree angle served the experimenter's purposes.

Subject: To exercise the flexors of the right elbow, the subject assumes a sitting position on the left half of the table top. The right arm is placed against the backrest while the forearm is placed in a position parallel to the table top but not resting on the table. The forearm may be in the supinated, pronated, or neutral position for this exercise depending upon the needs of the subject. The wrist cuff is placed on the subject's right wrist. Substitution may be reduced by strapping the upper arm 1 to 1 1/2 inches above the elbow to the table.

Exercise: The exercise is performed by flexing the elbow against the resistance provided by the table's pulley arrangement.

Note: To exercise the flexors of the left elbow, the procedures are repeated with the subject lying off center on the right half of the table and utilizing the left elbow.

II. Elbow Flexor Exercise: Sitting

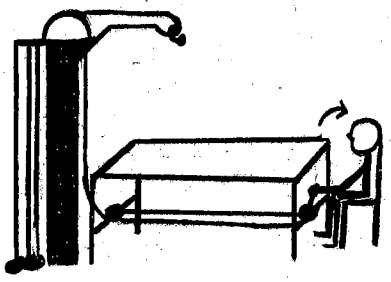

Figure 28

Table: The special pulley assembly is attached for operation as previously described on page 50. The metal handle is attached to the cuff by utilizing the snap buckle. The appropriate weights are placed on the weight pan.

Subject: The subject sits in a chair close to and facing the foot-end of the table. The elbow to be exercised is placed on the subject's thigh approximately 2 inches from the knee. The elbow is slightly extended so that the angle between the forearm and the upper arm is approximately 135 degrees. The wrist is locked in extension. The metal handle is placed in the subject's hand. This exercise may be performed with the forearm in supination or a semi-pronated, supinated position depending upon the needs of the subject.

Exercise: The subject flexes his elbow against the resistance offered by the table's pulley arrangement.

Elbow Extensor Exercises

I. Elbow Extensor Exercise: Half-Sitting

Table: The backrest is raised to approximately 45 degrees, and the table top pulley is attached for operation as previously described on page 48. The metal handle or wrist cuff is attached to the cable's

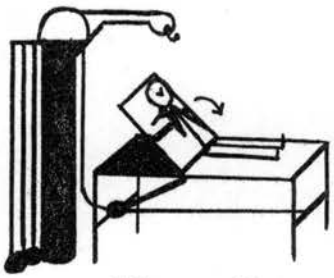

Figure 29

snap buckle. The appropriate weight is placed on the weight pan.

Subject: To exercise the extensors of the right elbow, the subject assumes a half-sitting position on the left half of the table top. The right upper arm is stabilized against the raised back-rest by utilizing the table strap. The elbow is completely flexed and positioned close to the upper arm. This position places the extensors on maximum stretch. The wrist cuff is attached to the subject's wrist, or the metal handle may be utilized if desired. The hand and forearm are pronated.

Exercise: The subject performing the exercise extends the elbow against the resistance offered by the table's pulley arrangement.

Note: To exercise the left elbow flexors, the same procedures are followed except that the subject should be positioned on the right side of the table.

II. Elbow Extensor Exercise: Sitting

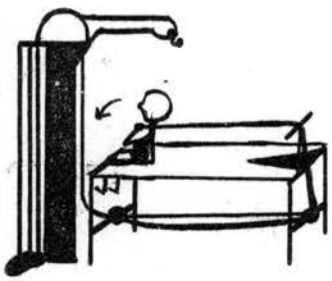

Figure 30

Table: The special pulley assembly is attached for operation as previously described on page 50. The bar and directional pulley assembly are positioned and locked into place 10 inches from the foot-end of the table. The supplementary

cable is attached to the snap buckle of the special pulley assembly, directed upward through the excursion area and over the directional pulley wheel. The wrist cuff or the metal handle is attached to the snap buckle of the supplementary cable. The appropriate weight is placed on the weight pan.

Subject: The subject assumes a sitting position 1 1/2 feet from the head-end of the table with his back to the bar. Due to the nature of the exercise, this seated position must be slightly off center away from the exercising arm. The pronated forearm is completely flexed and positioned close to the upper arm. The upper arm is placed on the thigh rest which has been placed vertically on the table top. The wrist cuff is attached to the subject's wrist, or the metal handle is grasped in the hand.

Exercise: The subject performs the exercise by extending the elbow against the resistance offered by the table's pulley arrangement.

Shoulder Abductor Exercises

I. Shoulder Abductor Exercise: Side-Lying

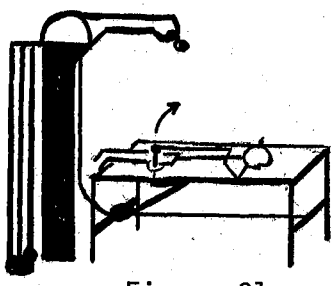

Figure 31

Table: The table top pulley is attached for operation as previously described on page 48. The metal handle or wrist cuff is attached to the cable's snap buckle. The appropriate weight is placed on the weight pan.

Subject: The subject assumes a side-lying position with legs at

the head-end of the table. The position should be adjusted as necessary to place the hand fartherest away from the table directly above the table top pulley. The subject rests his head on the opposite arm. The metal handle is placed in the subject's hand. The subject should be instructed to maintain the wrist and elbow in the extended position throughout the exercise arrangement. The forearm can be pronated, supinated, or in the neutral position.

Exercise: The exercise is performed by abducting the arm against the resistance provided by the table's pulley arrangement.

II. Shoulder Abductor Exercise: Standing

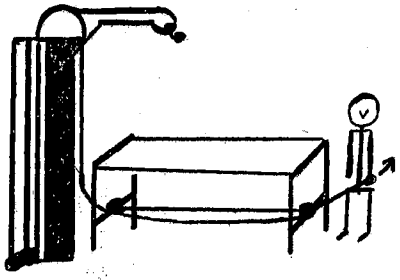

Figure 32

Table: The special pulley assembly is attached for operation as previously outlined on page 50. The metal handle or wrist cuff is attached to the snap buckle of the cable. The appropriate weights are placed on the weight pan.

Subject: The subject assumes an erect side-standing position at the foot-end of the table with the shoulder to be exercised fartherest from the table's edge. The arm is fully extended at the side. The forearm and wrist may be in any position, but a semi-pronated, supinated position is easiest. The metal handle is placed in the hand.

Exercise: To perform the exercise, the subject abducts the shoulder to 90 degrees against the resistance offered by the table's pulley

arrangement.

Note: The subject should be instructed to maintain the hand and wrist in the extended position throughout the exercise arrangement. If a greater range of movement is desired, a supplementary cable must be attached to the special pulley assembly's snap buckle. The same procedures would be followed except that the subject would need to stand farther away from the table's edge.

Shoulder Horizontal Abductor Exercises

I. Shoulder Horizontal Abductor Exercise: Standing

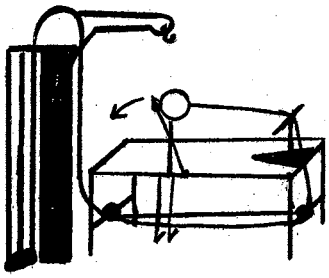

Figure 33

Table: The special pulley assembly is attached for operation as described in Chapter IV, page 50. The directional pulley wheel and bar are attached and stabilized into position 10 inches from the foot-end of the excursion area. A supplementary cable is attached to the special pulley assembly's snap buckle. It is passed through the boot carriage excursion area and across the directional pulley wheel. The metal handle is attached to the snap buckle on the end of the supplementary cable. The appropriate weights are added to the weight pan.

Subject: The subject assumes an erect standing position facing the side of the table and approximately 2 feet closer to the head-end than is the bar. The shoulder fartherest from the bar is flexed to

90 degrees. The arm and wrist are held in a semi-pronated, supinated position. The metal handle is grasped in the hand.

Exercise: The subject horizontally abducts the shoulder against the resistance offered by the table's pulley arrangement.

Note: The subject should be instructed to maintain the elbow and the wrist in the extended position throughout the exercise. Rotation of the trunk or other substitution should be avoided.

II. Shoulder Horizontal Abductor Exercise: Standing

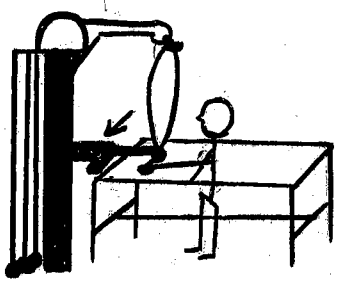

Figure 34

Table: The hip abductor assembly is attached to the overhead pulley and locked into position as described in Chapter IV, page 47. The metal handle is attached to the snap buckle on the cable nearest the subject. The appropriate weights are added to the weight pan.

Subject: The subject assumes a side-standing position 1 1/2 feet back from and facing the head-end of the table with the shoulder to be exercised fartherest from the table's edge. The shoulder to be exercised is flexed to 90 degrees. The elbow is extended, and the wrist is held in a semi-pronated, supinated position throughout the exercise arrangement. The metal handle from the hip abductor assembly is grasped in the hand.

Exercise: The exercise is performed by horizontally abducting the shoulder against the resistance offered by the table's pulley

arrangement.

Note: Rotation of the trunk or other substitution should be avoided.

Shoulder Adductor Exercises

I. Shoulder Adductor Exercise: Standing

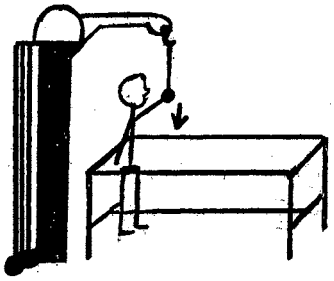

Figure 35

Table: The overhead pulley assembly is attached for operation as outlined in Chapter IV, page 46. The metal handle is hooked to the pulley's snap buckle, and the appropriate weight is placed on the weight pan.

Subject: The subject assumes a standing position at the side of the table with the shoulder to be exercised closest to the table's edge. The shoulder is abducted 90 degrees. The elbow is extended and the wrist and forearm pronated. The subject should be instructed to maintain this position throughout the exercise. The metal handle is grasped in the subject's hand.

Exercise: The exercise is performed by adducting the shoulder against the resistance applied by the table's pulley arrangement.

Note: Substitution of the trunk or leg flexors should be avoided.

II. Shoulder Adductor Exercise: Standing

Table: The special pulley assembly is attached for operation as described on page 50. The metal handle is attached to the pulley's

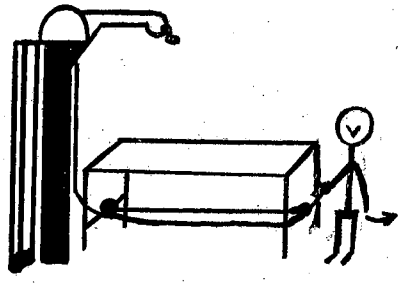

Figure 36

snap buckle. The appropriate weight is placed on the weight pan.

Subject: The subject assumes a side-standing position at the end of the table with the shoulder to be exercised closest to the table's edge. The shoulder is abducted to 45 degrees with the elbow and wrist pronated and extended. The subject should be instructed to maintain the elbow and wrist in this position throughout the exercise. The metal handle is grasped in the subject's hand.

Exercise: The subject adducts the shoulder against the resistance provided by the table's pulley arrangement.

Note: Substitution of the trunk or leg flexors should be avoided.

Shoulder Horizontal Adductor Exercises

I. Shoulder Horizontal Adductor Exercise: Sitting

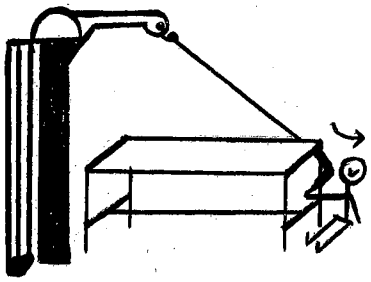

Figure 37

Table: The hip rotator assembly is attached for operation as outlined on page 50. The metal handle is attached to the supplementary cable, and the appropriate weight is placed on the weight pan.

Subject: The subject assumes a long sitting position on the floor parallel to and at arm's length

from the foot-end of the table. The shoulder is abducted to 90 degrees with elbow extended and the wrist semi-pronated, supinated, and extended. The subject should be instructed to maintain this position with the elbow and wrist throughout the exercise. The metal handle is placed in the subject's hand.

Exercise: The exercise is performed by horizontally adducting the shoulder against the resistance offered by the table's pulley arrangement.

Note: Trunk rotation should be avoided.

II. Shoulder Horizontal Adductor Exercise: Standing

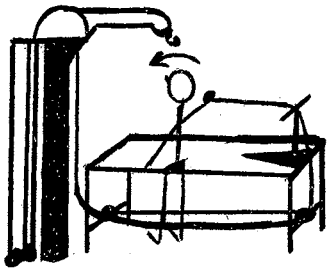

Figure 38

Table: The special pulley assembly is attached for operation as described on page 50. The bar and directional pulley wheel are placed into a position 10 inches from the foot of the table. The supplementary cable is attached to the snap buckle of the special pulley assembly, passed through the boot carriage excursion area and over the directional pulley wheel. The metal handle is attached to the supplementary cable at this point. The appropriate weight is placed on the weight pan.

Subject: The subject assumes a side-standing position with his back approximately 2 feet closer to the head-end of the table than is the bar. This position should be adjusted until he stands obliquely to

the table, thereby forming a 45-degree angle between the table's edge and his body. The shoulder to be exercised is closest to the bar and should be placed in a position of 90 degrees abduction. The elbow is extended, and the wrist and forearm are in a semi-pronated, supinated position. The subject should be instructed to maintain the position of the wrist and elbow throughout the exercise. The metal handle is placed in the subject's hand.

Exercise: The exercise is performed by horizontally adducting the shoulder against the resistance provided by the table's pulley arrangement.

Note: The rotation of the trunk should be avoided.

Shoulder Flexor Exercises

I. Shoulder Flexor Exercise: Supine

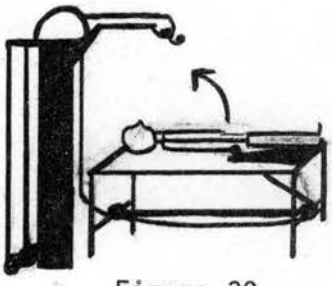

Figure 39

Table: The special pulley assembly is attached for operation as previously described on page 50. A supplementary cable is attached to the special pulley assembly's snap buckle and passed through the boot carriage excursion area in the table top. The metal handle or wrist cuff is attached to the snap buckle of the supplementary cable. The appropriate weight is selected and placed on the weight pan.

Subject: To exercise the shoulder flexors of the right shoulder, the subject assumes a supine position on the left half of the table.

The left arm may grasp the side of the table for support. The right elbow is extended, and the wrist may be pronated, supinated, or in the neutral position. The subject should be instructed to maintain the position of the wrist and elbow throughout the exercise. The metal handle is placed in the hand, or the wrist cuff is attached to the wrist.

Exercise: The exercise is performed by flexing the shoulder against the resistance provided by the table's pulley arrangement.

Note: To exercise the flexors of the left shoulder, place the subject on the right half of the table top and repeat the above procedures with the left shoulder.

II. Shoulder Flexor Exercise: Standing

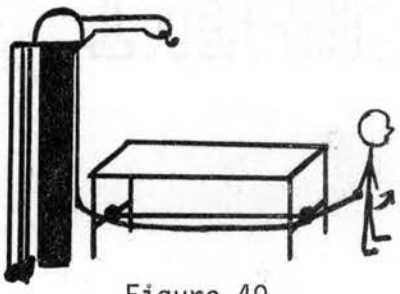

Figure 40

Table: The special pulley assembly is attached for operation as previously described on page 50. The metal handle is attached to the cable by utilizing the snap buckle. The appropriate weight is placed on the weight pan.

Subject: The subject assumes an erect standing position with his back to the foot-end of the table. The arms are straight and held close to the sides. The elbow is extended, and the wrist may be supinated, pronated, or in the neutral position. The subject should be instructed to maintain the wrist and elbow in this position throughout the entire exercise arrangement. The

metal handle is grasped in the hand.

Exercise: The exercise is performed by flexing the shoulder to 90 degrees against the resistance provided by the table's pulley arrangement.

Note: Substitution of other muscle groups should be avoided.

Shoulder Extensor Exercises

I. Shoulder Extensor Exercise: Supine

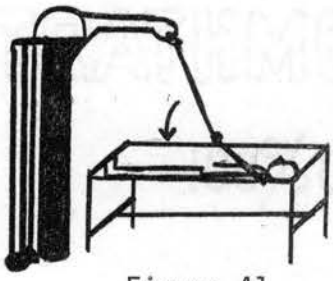

Figure 41

Table: The overhead pulley is positioned along the track and attached for operation as described on page 46. The metal handle (or the wrist cuff) is attached to the cable's snap buckle. The appropriate weights are placed on the weight pan.

Subject: The subject assumes a supine position on the table with his head at the foot-end. To allow a wider range of movement, the subject's shoulder joint may be positioned 1 to 2 inches off the table's edge to allow the shoulder to be extended past the plane of the table. The shoulder to be exercised is placed in a position of 45 degrees flexion, with the elbow extended and wrist pronated and extended. The subject should be instructed to maintain the elbow and wrist in this position throughout the exercise. The metal handle is grasped in the hand.

Exercise: The exercise is performed by extending the shoulder as

far as possible against the resistance provided by the table's pulley arrangement.

II. Shoulder Extensor Exercise: Standing

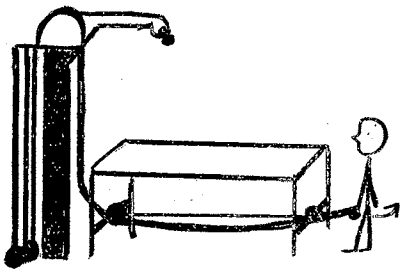

Figure 42

Table: The special pulley assembly is attached for operation as previously outlined in Chapter IV, page 50. The metal handle is attached to the cable's snap buckle. The appropriate weight is selected and placed on the weight pan.

Subject: The subject assumes an erect standing position facing the foot-end of the table. This position should be slightly off center to allow more freedom of movement. The arms are straight and held close to the sides. The elbow should be extended and the wrist pronated and extended. This position of the elbow and the wrist should be maintained throughout the exercise arrangement. The metal handle is grasped in the subject's pronated hand.

Exercise: The subject performs the exercise by hyperextending the shoulder as far as possible against the resistance provided by the table's pulley arrangement.

Note: Substitution by other muscle groups should be avoided.

Shoulder Lateral Rotator Exercises

I. Shoulder Lateral Rotator Exercise: Supine

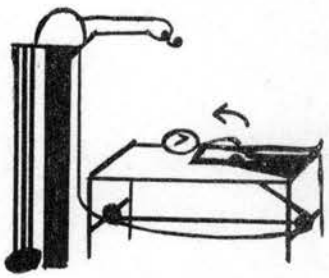

Figure 43

Table: The special pulley assembly is attached for utilization as described on page 50. The supplementary cable is attached to the assembly's snap buckle and passed through the carriage excursion area in the table top. The metal handle is attached to the supplementary cable by utilizing the snap buckle. The appropriate weight is placed on the weight pan.

Subject: The subject assumes a supine position on the table with shoulders parallel to and 2 inches above the intersection of the head and foot sections. The shoulder is medially rotated and abducted to 90 degrees. The elbow is flexed to 90 degrees, and the forearm is positioned parallel to the trunk. The wrist is extended and pronated. The subject should be instructed to keep the elbow flexed and the upper arm on the table. The metal handle is grasped in the hand.

Exercise: The exercise is performed by rotating the shoulder laterally against the resistance applied by the table's pulley arrangement.

Note: The exercise range should be 180 degrees.

II. Shoulder Lateral Rotator Exercise: Sitting

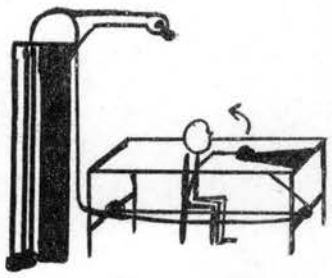

Figure 44

Table: The special pulley assembly is attached for utilization as previously described on page 50. Prior to the exercise, the cable from the special pulley assembly is passed through the boot carriage excursion area in the table top. The metal handle is attached to the cable by utilizing the snap buckle. The appropriate weight is placed on the weight pan.

Subject: The subject assumes a sitting position in a chair facing the foot-end and placed at the side of the table 3 inches below the intersection of the head and foot section of the table. The shoulder is medially rotated and abducted to 90 degrees, with the elbow flexed to 90 degrees and the entire arm rested on the table. The forearm and wrist are pronated. The subject should be instructed to maintain the position of the elbow and the wrist and keep the upper arm in contact with the table throughout the exercise arrangement. The metal handle is grasped in the hand.

Exercise: The exercise is performed by rotating the shoulder laterally against the resistance offered by the table's pulley arrangement.

Note: The exercise range should be approximately 90 degrees.

Shoulder Medial Rotator Exercises

I. Shoulder Medial Rotator Exercise: Supine

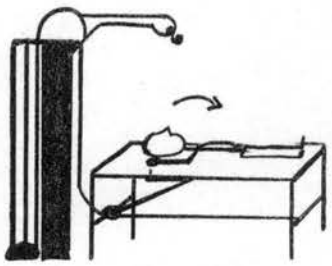

Figure 45

Table: The table top pulley is attached for operation as previously described on page 48. The metal handle is attached to the cable's snap buckle. The appropriate weight is added to the weight pan.

Subject: To exercise the medial rotators of the right shoulder, the subject assumes a supine position on the left half of the table top. The right shoulder is laterally rotated and abducted 90 degrees. The entire arm is rested on the table. The elbow is flexed to 90 degrees, and the wrist is extended and pronated. The subject should be instructed to maintain the angle of the elbow and to keep the upper arm in contact with the table throughout the exercise. The metal handle is grasped in the hand.

Exercise: The exercise is performed by rotating the shoulder medially against the resistance provided by the table's pulley arrangement.

Note: The exercise range should be 180 degrees. To exercise the left medial rotators, the same procedures are followed except that the subject should be positioned on the right half of the table.

II. Shoulder Medial Rotator Exercise: Sitting

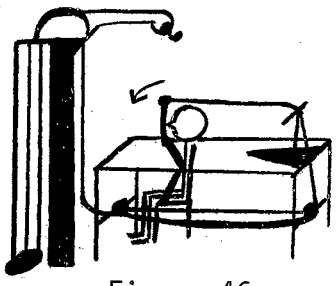

Figure 46

Table: The special pulley assembly is attached for operation as outlined on page 50. The bar and directional pulley wheel are placed into position 10 inches from the foot-end of the table. The supplementary cable is attached to the assembly's snap buckle, passed through the boot carriage excursion area and over the directional pulley wheel. The metal handle is attached to the snap buckle. The appropriate weight is placed on the weight pan.

Subject: The subject assumes a sitting position facing the head-end of the table in a chair placed at the side of the table and 1 1/2 feet back from the head-end of the table. The shoulder is abducted to 90 degrees, and the upper arm is rested on the table top. The elbow is flexed to 90 degrees and held perpendicular to the table top. The forearm and wrist are pronated. The subject should be instructed to maintain the position of the elbow flexion, to keep the upper arm in contact with the table, and to keep the wrist extended and pronated throughout the exercise. The metal handle is grasped in the subject's hand.

Exercise: The exercise is performed by rotating the shoulder medially against the resistance offered by the table's pulley arrangement.

Note: The exercise range should be 90 degrees.

Shoulder Elevator Exercises

I. Shoulder Elevator Exercise: Standing

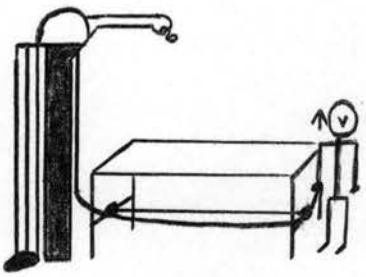

Figure 47

Table: The special pulley assembly is attached for operation as previously described in Chapter IV, page 50. The metal handle is attached to the cable's snap buckle. The appropriate weight is placed on the weight pan.

Subject: The subject assumes an erect standing position at the end of the table with the shoulder to be exercised closer to the table's edge. The arms are straight and held close to the body. The elbows are locked in extension, and the wrists are in a semi-pronated, supinated position. This position should be maintained throughout the exercise. The metal handle is placed in the hand.

Exercise: The exercise is performed by elevating the shoulder against the resistance provided by the table's pulley arrangement.

Note: The body should be held erect during the exercise. There should not be any tilting or lateral flexion in the trunk area.

II. Shoulder Elevator Exercise: Supine

Table: The special pulley assembly, bar, and directional pulley wheel are attached for operation as described on pages 50 and 58. The exact angle and height of the bar will be dependent on the subject being

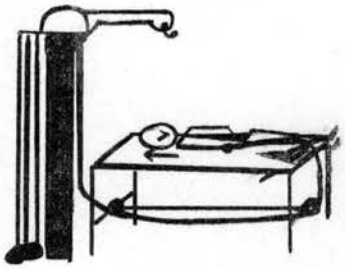

Figure 48

exercised. However, for most subjects, the angle of the bar will be approximately 45 degrees. The position of the bar should be approximately 1 foot from the foot-end of the excursion area. The usual height is 1 to 2 inches above the table top. The supplementary cable is attached to the assembly's snap buckle, passed up and over the directional pulley wheel positioned on the bar extending out slightly from the table's top. The metal handle is attached to this end of the supplementary cable.

Subject: The subject assumes a supine position on the half of the table top opposite that of the arm to be exercised. The arms are straight and held close to the sides. The elbow is locked into extension while the wrist is extended and in a semi-pronated, supinated position. The feet may be positioned against the extension projecting outward from the bar. The metal handle is placed on the subject's hand.

Exercise: The exercise is performed by elevating the shoulder against the resistance provided by the table's pulley arrangement.

Note: The trunk should be stabilized during the exercise. Lateral flexion or tilting of the trunk should be avoided.

Upper Back Extensor Exercises

I. Upper Back Extensor Exercise: Prone

Table: The special pulley assembly is attached for operation as described on page 50. The appropriate weight is placed on the weight

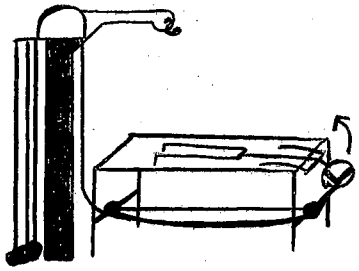

Figure 49

pan.

Subject: When the head harness has been snugly affixed, the subject assumes a prone position on the table with the head and shoulders extended beyond the foot-end of the table. The arms are straight and held close to the body. The head and shoulders are below the table top level. Stabilization below the shoulders may be necessary. The snap buckle is attached to the D-ring provided on the front of the head harness.

Exercise: The exercise is performed by extending the upper spine against the resistance provided by the table's pulley arrangement.

Note: The head should not be tilted backward or the trunk raised from the table. If the muscles of the neck are weak, it is suggested that another exercise arrangement be utilized.

II. Upper Back Extensor Exercise: Sitting

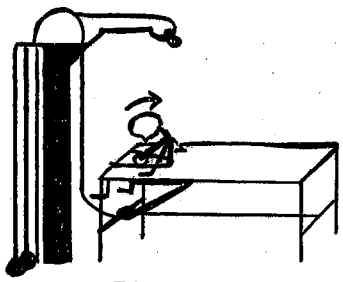

Figure 50

Table: The table top assembly is attached for operation as described on page 48. The appropriate weight is placed on the weight pan.

Subject: After the shoulder harness has been securely attached, the subject assumes a sitting position facing and 1 1/2 feet back

from the head-end of the table. The upper legs are positioned to either side of the table top pulley's circular indention in the table. The hands may be placed on the sides of the table for support. The upper back is flexed and the neck is slightly flexed. The snap buckle from the cable is attached to the metal projection on the shoulder harness.

Exercise: The exercise is performed by extending the upper spine against the resistance provided by the table's pulley arrangement.

Note: Movement should occur only in the upper back. Substitution of other muscle groups should be avoided.

Trunk Extensor Exercises

I. Trunk Extensor Exercise: Prone

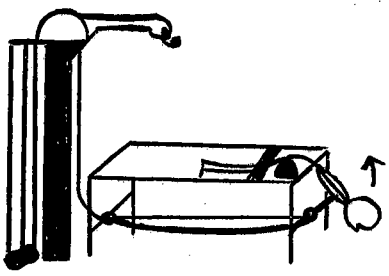

Figure 51

Table: The special pulley assembly is attached for operation as outlined in Chapter IV, page 50. The resistance to the exercise is provided by the placement of the appropriate weights on the weight pan.

Subject: After the shoulder harness has been firmly attached, the subject assumes a prone position on the table top with the upper trunk flexed over the foot-end of the table. The pelvic rest is positioned directly under the trochanters. The arms are positioned either behind the head or locked behind the back. The snap buckle from the special pulley assembly is attached to

the metal projection on the shoulder harness. Stabilization at the hips is necessary.

Exercise: To perform the exercise, the subject extends the trunk against the resistance offered by the table's pulley arrangement.

Note: The extension should be done without any lateral flexion in the trunk area. The head and shoulders should be raised upward in line with the spine.

II. Trunk Extensor Exercise: Prone

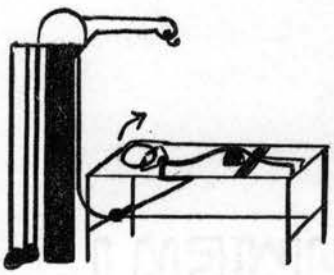

Figure 52

Table: The table top pulley is attached for operation as previously outlined on page 48. The appropriate weight is placed on the weight pan.

Subject: After the shoulder harness has been firmly attached, the subject assumes a prone position on the table top with the chest directly over the table top pulley. The pelvic rest is positioned directly under the trochanters. The arms are positioned either behind the head or behind the back. The snap buckle from the table top pulley is attached to the metal projection on the shoulder harness. Stabilization at the hips is necessary.

Exercise: The exercise is performed by hyperextending the trunk against the resistance offered by the table's pulley arrangement.

Note: The head and shoulders should be raised upward in line with the spine. Lateral flexion or twisting should be avoided.

Trunk Flexor Exercises

I. Trunk Flexor Exercise: Supine

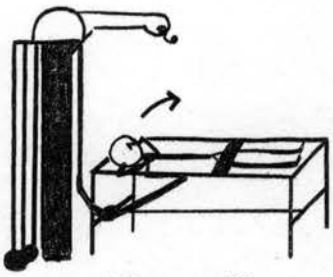

Figure 53

Table: The table top pulley assembly is attached for operation according to the procedures outlined in Chapter IV, page 48. The appropriate weight is placed on the weight pan.

Subject: After the shoulder harness has been securely attached, the subject assumes a supine lying position on the table with the hands placed behind the neck. The snap buckle from the table top pulley is attached to the metal projection on the shoulder harness. Stabilization is needed at hip height to prevent the raising of the hips from the table. However, the legs and feet should not be stabilized.

Exercise: The exercise is performed by curling the head and spine forward until the scapulae leave the table.

II. Trunk Flexor Exercise: Sitting

Table: The special pulley assembly, bar, and directional pulley wheel are attached for operation as previously described on pages 50 and 58. The angle of the bar should be 90 degrees while the height will be dependent upon the individual's needs. The bar should be positioned and locked into place 10 inches from the foot-end of the excursion area. The supplementary cable is attached to the snap buckle, passed through

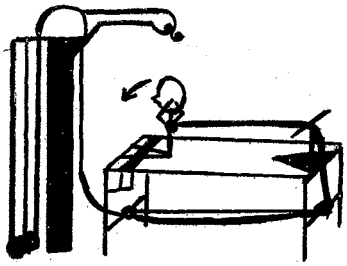

Figure 54

the carriage excursion area and across the directional pulley wheel. The exact height and angle of the bar will depend on the subject being exercised. The appropriate weight is placed on the weight pan.

Subject: After the shoulder harness has been firmly attached, the subject assumes a long sitting position on the table top facing the weight pan and 1 1/2 feet back from the head-end of the table. The legs will need to be stabilized above the knees. The arms may be positioned behind the back or behind the neck. The snap buckle from the supplementary cable is attached to the metal projection on the shoulder harness.

Exercise: The exercise is performed by flexing the trunk against the resistance offered by the table's pulley arrangement.

Trunk Rotator Exercises

I. Trunk Rotator Exercise: Sitting

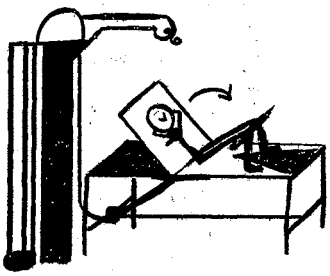

Figure 55

Table: The table top pulley is attached for use as described in the preceding chapter on page 48. The backrest is raised to a position of approximately 50 degrees. The appropriate weight is placed on the weight pan.

Subject: After the shoulder

harness has been firmly attached, the subject assumes a modified sitting position following the contour of the table. The legs may be extended or the knees flexed over the two extensions on the carriage. If the carriage is utilized, the height and angle will depend on the subject doing the exercise. In addition, stabilization of the legs or feet may be necessary. Prior to the exercise, the snap buckle from the table top pulley is attached to the metal projection on the shoulder harness. The hands are positioned behind the head.

Exercise: The exercise is performed by raising the trunk to a sitting position, keeping the elbows back in line with the shoulders and twisting the trunk to the left, touching the right elbow to the left knee. The exercise is then repeated, touching the left elbow to the right knee.

II. Trunk Rotator Exercise: Sitting

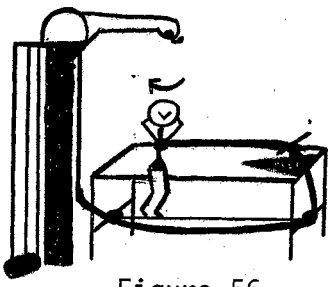

Figure 56

Table: The special pulley assembly, bar, and directional pulley wheel are attached for operation as previously described on pages 50 and 58. The angle of the bar should be 90 degrees while the height will be dependent upon the individual's needs. The bar should be positioned and locked into place 10 inches from the foot-end of the excursion area. The supplementary cable is attached to the assembly's snap buckle, passed through the carriage excursion area and over the

directional pulley wheel. The appropriate weight is placed on the weight pan.

Subject: After the shoulder harness has been firmly attached, the subject assumes a correct sitting position on the side of the table with the rotators to be exercised next to the bar. The fingers are placed behind the neck, and the elbows are positioned in line with the shoulders. The snap buckle from the supplementary cable is attached to the shoulder harness.

Exercise: The exercise is performed by rotating the trunk against the resistance provided by the table's pulley arrangement. The elbows, which are maintained in a position in line with the shoulders, are turned as far away from the bar as possible.

Note: The head and trunk should not be allowed to move forward. To exercise the opposite side, the subject should sit on the other side of the table top.

Trunk Lateral Flexor Exercises

I. Trunk Lateral Flexor Exercise: Side-Lying

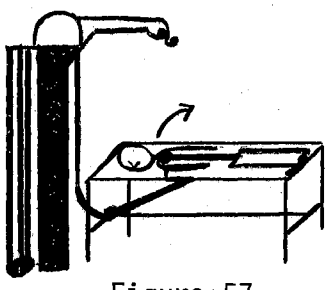

Figure 57

Table: The table top pulley assembly is attached for use as previously outlined on page 48. The appropriate weight is placed on the weight pan.

Subject: After the shoulder harness has been firmly attached, the subject assumes a side-lying position with the metal projection

on the harness directly above the table top pulley. The legs are straight, and the arms are positioned close to the body. Stabilization at the hips is necessary to avoid their raising during the exercise. Prior to the exercise, the snap buckle from the table top pulley is attached to the snap on the shoulder harness.

Exercise: The exercise is performed by laterally flexing the trunk against the resistance offered by the table's pulley arrangement.

Note: The rotating of the pelvis to the right or left should be avoided. In addition, twisting of the body should be eliminated. The exercise may be repeated on the other side if desired.

II. Trunk Lateral Flexor Exercise: Sitting

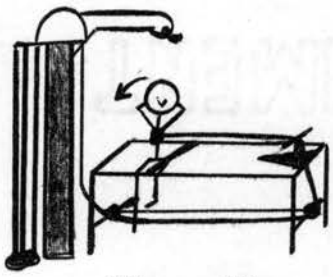

Figure 58

Table: The special pulley assembly, bar, and directional pulley wheel are attached for operation as described in Chapter IV on pages 50 and 58. The angle of the bar should be 90 degrees while the height will be dependent upon the individual's needs. The bar should be positioned and stabilized 10 inches from the foot-end of the excursion area. The supplementary cable is attached to the assembly's snap buckle, passed through the boot carriage excursion area and over the directional pulley wheel. The appropriate weight is added to the weight pan.

Subject: After the shoulder harness has been firmly attached, the

subject assumes a sitting position on the side of the table 1 1/2 feet from the head-end with the lateral flexors to be exercised next to the bar. The fingers are placed behind the neck, and the elbows are positioned in line with the shoulders. The snap buckle from the supplementary cable is attached to the metal projection on the shoulder harness. Stabilization at the hips is necessary.

Exercise: The exercise is performed by laterally flexing the trunk against the resistance provided by the table's pulley arrangement.

Note: If undue substitution is observed, one of the other exercise arrangements, reducing substitution to a minimum, is suggested. Rotating the pelvis to the right of left, as well as twisting the body, should be avoided. Repeat using other side, if desired.

Hip Flexor Exercises

I. Hip Flexor Exercise: Sitting

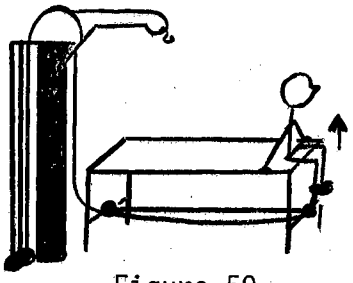

Figure 59

Table: The special pulley arrangement is attached for operation as previously described on page 50. The appropriate weight is placed on the weight pan.

Subject: After the quadriceps boot is attached, the subject assumes a sitting position on the foot end of the table. The lower one-third of the thigh is extended beyond the table edge. The knee is flexed to 90 degrees, and the ankle is slightly-dorsi-flexed. This position of the knee and ankle should be maintained

throughout the exercise. The hands are placed on the table top for support. The cable is attached to the quadriceps boot by threading it through the circular slot in the bottom of the boot and attaching the snap buckle around the cable itself.

Exercise: The exercise is performed by flexing the hip against the resistance offered by the table's pulley assembly.

Note: In this exercise, the knee is flexed to allow the sartorius to be lengthened through a greater range of movement. Shifting of the weight laterally should be avoided.

II. Hip Flexor Exercise: Standing

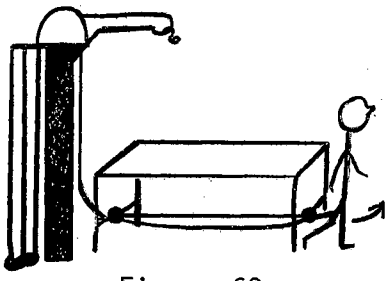

Figure 60

Table: The special pulley assembly is attached for operation as previously described on page 50. The appropriate weight is placed on the weight pan.

Subject: The subject assumes an erect standing position with his back to the foot-end of the table. The arms are utilized for balance. With increased exercise loads, it is suggested that the hands be placed on two chairs, positioned to either side of the body. The knee is slightly flexed, and the hip is slightly hyperextended. The thigh cuff is securely affixed to the subject's thigh 1 to 2 inches above the knee. The cable's snap buckle is attached to the D-ring provided on the back of the cuff.

Exercise: The exercise is performed by flexing at the hip against

the resistance provided by the table's pulley arrangement. Flexion or hyperextension of the trunk should be avoided.

Note: In this exercise, the knee is flexed to allow the sartorius to be lengthened through a greater range of movement. If desired, when the knee is not weak, the exercise could be performed with an extended knee utilizing the ankle cuff. In this instance, all the one-joint muscles are forced to contract in order to maintain the position of the knee. Since the lever has been lengthened, less resistance will be needed.

Hip Extensor Exercises

I. Hip Extensor Exercise: Prone

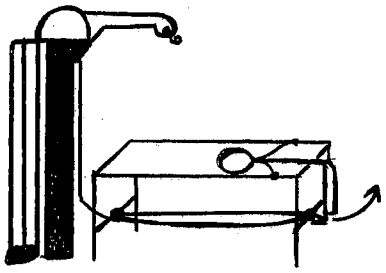

Figure 61

Table: The special pulley assembly is attached for operation as previously described on page 50. The appropriate weight is placed on the weight pan.

Subject: After the foot stirrup has been attached to the foot, the subject assumes a prone position on the table with the lower extremity flexed at the hip over the foot-end of the table. The knee is locked into extension, and the ankle is slightly dorsi-flexed. The hands are placed on the sides of the table for support. Stabilization at the shoulders may be necessary to reduce substitution. The snap buckle of the assembly is attached to the D-ring on the top of the foot stirrup.

Exercise: The subject extends the hip against the resistance provided by the table's pulley assembly. The exercise range should be 90 degrees.

Note: In this exercise, the knee is extended in order to exercise the gluteals and hamstrings simultaneously. If the thigh cuff was utilized and the knee was slightly flexed, the extension of the hip would result primarily from gluteal contraction.

II. Hip Extensor Exercise: Standing

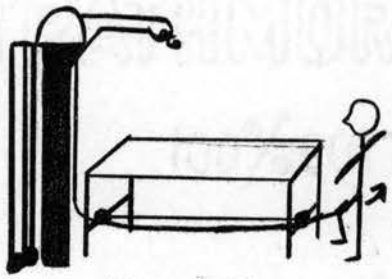

Figure 62

Table: The special pulley assembly is attached for operation as previously described on page 50. The appropriate weight is placed on the weight pan.

Subject: The subject assumes an erect standing position facing the foot-end of the table. The arms are utilized for balance. With increased exercise loads, it is suggested that the hands be placed on two chairs, positioned to either side of the body. The knee and hip are slightly flexed. The thigh cuff is securely attached to the subject's thigh 1 to 2 inches above the knee. The cable's snap buckle is attached to the D-ring provided on the back of the cuff.

Exercise: The exercise is performed by extending at the hip against the resistance provided by the table's pulley arrangement. Flexion of the trunk should be avoided.

Note: In this exercise, the knee is flexed in order to exercise, primarily the gluteals. With the knee extended, the gluteals and hamstrings would be exercised simultaneously.

Hip Abductor Exercises

I. Hip Abductor Exercise: Standing

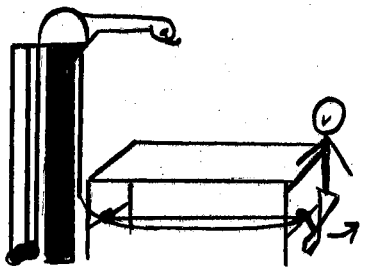

Figure 63

Table: The special pulley assembly is attached for operation as previously described on page 50. The appropriate weight is placed on the weight pan.

Subject: The subject assumes a side-standing position at the foot-end of the table with the hip to be exercised fartherest from the table's edge. The hand closer to the table is placed on the table's edge for support. The thigh cuff is attached to the subject's thigh 1 to 2 inches above the knee. The hip to be exercised is adducted to a position so that the feet are crossed. The cable's snap buckle is attached to the D-ring provided on the medial side of the cuff.

Exercise: The exercise is performed by abducting the hip against the resistance provided by the table's pulley arrangement.

Note: Lateral flexion of the trunk should be avoided. The exercise could be performed by utilizing the ankle cuff. In this instance, though, stress is placed on the lateral collateral ligament. To avoid injury to the ligament, the movement of heavy loads should

never be attempted by the knee.

II. Hip Abductor Exercise: Side-Lying

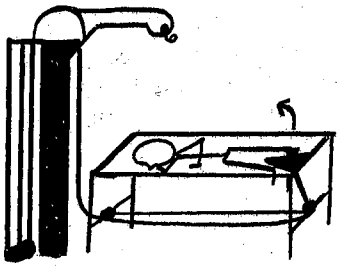

Figure 64

Table: The special pulley assembly is attached for operation as previously described in Chapter IV on page 50. The appropriate weight is placed on the weight pan.

Subject: The ankle cuff or the foot stirrup is attached to the subject. The subject assumes a side-lying position on the table with the cuff or stirrup directly above the boot carriage excursion area. The subject's top leg is the one which will be exercised in this arrangement. The lower leg is flexed slightly at the hip so that it will not be in the way of the exercising leg. If necessary, it can be stabilized to the table top by utilizing one of the straps. The leg to be exercised is positioned above the pulley assembly by extending the hip, locking the knee in extension and the ankle in dorsi-flexion. This position of the knee and ankle should be maintained throughout the exercise. The arms may be positioned at the subject's sides, or the subject may rest his head on one of the folded arms while the other rests on the table top for support. The snap buckle from the special pulley assembly is attached to the D-ring on the medial side of the foot stirrup or the ankle cuff.

Exercise: The exercise is performed by abducting the hip against the resistance offered by the table's pulley arrangement.

Note: Lateral flexion of the trunk should be avoided. The exercise could be performed by utilizing the thigh cuff and thus reducing the stress on the lateral collateral ligament. If heavy exercise loads are utilized, the thigh cuff should be used.

Hip Adductor Exercises

I. Hip Adductor Exercise: Side-Lying

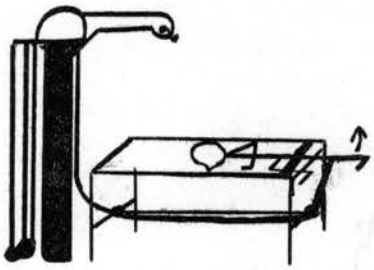

Figure 65

Table: The special pulley assembly is attached for operation as previously outlined in Chapter IV on page 50. The appropriate weight is placed on the weight pan.

Subject: To exercise the right hip adductors, the thigh cuff is attached 1 to 2 inches above the right knee. The subject assumes a right-side lying position on the table with the lower legs and distal one-third of the thighs extended beyond the foot-end of the table. The left hip and knee are flexed to 90 degrees and stabilized to the table by a strap attached 1 to 2 inches below the knee. The right hip is extended. The knee is locked in extension, and the ankle is maintained in a plantar flexed position. The snap buckle is attached to the thigh cuff's D-ring positioned on the lateral side of the thigh.

Exercise: The exercise is performed by adducting the hip against the resistance provided by the table's pulley arrangement.

II. Hip Adductor Exercise: Standing

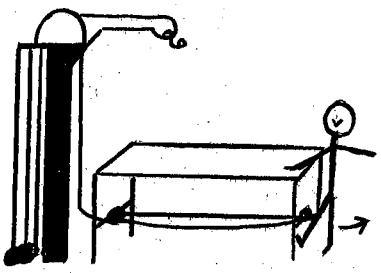

Figure 66

Table: The special pulley assembly is attached for operation as described on page 50. The appropriate weight is placed on the weight pan.

Subject: The subject assumes a side-standing position at the foot-end of the table with the hip to be exercised closer to the table. The hand closer to the table is placed on the table's edge for support. The thigh cuff is attached to the subject's thigh 1 to 2 inches above the knee. The hip to be exercised is slightly abducted. The cable's snap buckle is attached to the D-ring provided on the lateral side of the cuff.

Exercise: The exercise is performed by adducting the hip against the resistance provided by the table's pulley arrangement.

Note: Lateral flexion of the trunk should be avoided. This exercise could be performed by utilizing the ankle cuff. In this instance, though, stress is placed on the medial collateral ligament. To avoid injury to this ligament, the movement of heavy loads should never be attempted by the knee.

Hip Medial Rotator Exercises

I. Hip Medial Rotator Exercise: Sitting

Table: The special pulley assembly is attached for operation as

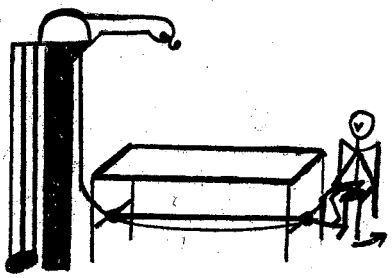

Figure 67

previously described in Chapter IV, page 50. The appropriate weight is placed on the weight pan.

Subject: After the ankle cuff has been attached, the subject assumes a sitting position in a chair positioned at the end of and 1 foot from the foot of the table. The hip to be exercised is fartherest from the table's edge. The thighs are stabilized to the chair by utilizing one of the table straps or a supplementary strap. The foot closest to the table is placed under the chair. The other leg is flexed to 90 degrees at the knee and ankle. This position should be maintained throughout the exercise. If needed, the thigh rest may be positioned under the thigh to allow a greater range of movement and help prevent substitution. The buckle from the special pulley assembly is snapped to the D-ring on the medial side of the cuff or stirrup.

Exercise: The exercise is performed by rotating the thigh medially against the resistance provided by the table's pulley arrangement.

Note: The knee and ankle must be maintained in the 90-degree flexed position. The ankle is moved laterally while the knee is maintained in the same relative position throughout the exercise.

II. Hip Medial Rotator Exercise: Standing

Table: The special pulley assembly, bar, and directional pulley wheel are attached for operation as previously described on pages 50 and 58. The angle of the bar should be 90 degrees while the height of

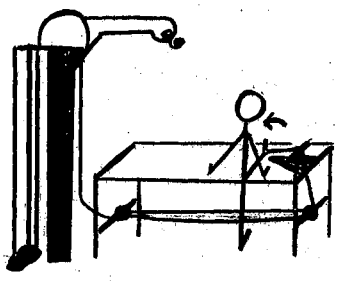

Figure 68

the bar will be dependent upon the subject performing the exercise. The bar should be positioned and stabilized 10 inches from the foot-end of the excursion area. The supplementary cable is attached to the special pulley assembly's snap buckle, passed through the boot carriage excursion area and over the directional pulley wheel. The appropriate weight is placed on the weight pan.

Subject: To exercise the right hip medial rotators, the subject assumes an erect standing position at the side of the table and facing it with the weight pan on his left. Prior to the exercise, the stirrup is attached to the subject's foot, and the leg is lifted and placed across the width of the table. The knee is extended and should be maintained in this position throughout the exercise. The hands may be placed on the table top for support. The hip is laterally rotated, and the snap buckle is attached to the D-ring provided on the lateral aspect of the stirrup.

Exercise: The exercise is performed by medially rotating the hip against the resistance provided by the table's pulley arrangement.

Note: Unless the subject is tall enough to rest the leg comfortably on the table, this exercise should not be performed. To exercise the medial rotators of the left leg, the same procedures are followed except the subject assumes the standing position at the side of the table and facing it, with the weight pan on his right.

Hip Lateral Rotator Exercises

I. Hip Lateral Rotator Exercise: Sitting

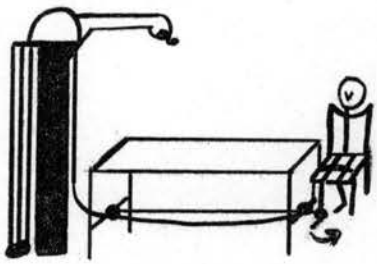

Figure 69

Table: The special pulley assembly is attached for operation as previously described on page 50. The appropriate weight is placed on the weight pan.

Subject: After the ankle cuff has been attached, the subject assumes a correct sitting position in a chair positioned perpendicular to and 1 foot from the foot-end of the table. The thighs are stabilized to the chair by utilizing one of the table straps or a supplementary strap. The foot fartherest from the table is placed under the chair. The closer leg is flexed to 90 degrees at the knee and ankle. This position should be maintained throughout the exercise. If needed, the thigh rest may be positioned under the thigh to allow a greater range of movement and help prevent substitution. The snap buckle from the special pulley assembly is snapped to the D-ring on the lateral side of the cuff or stirrup.

Exercise: The exercise is performed by rotating the hip laterally against the resistance provided by the table's pulley arrangement.

Note: The knee and ankle must be maintained in the 90 degree flexed position. The ankle is moved medially while the knee is maintained in the same relative position throughout the exercise.

II. Hip Lateral Rotator Exercise: Standing

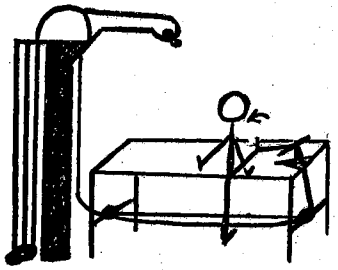

Figure 70

Table: The special pulley assembly, bar, and directional pulley wheel are attached for operation as described on pages 50 and 58. The angle of the bar should be 90 degrees while the height of the bar will be dependent upon the subject performing the exercise. The bar should be positioned and stabilized 10 inches from the foot-end of the excursion area. The supplementary cable is attached to the special pulley assembly's snap buckle, passed through the boot carriage excursion area and over the directional pulley wheel. The appropriate weight is placed on the weight pan.

Subject: To exercise the left hip lateral rotators, the subject assumes an erect standing position at the side of the table and facing it, with the weight pan on his left. Prior to the exercise, the stirrup is attached to the subject's foot, and the leg is lifted and placed across the width of the table. The knee is extended and should be maintained in this position throughout the exercise. The hands may be placed on the table top for support. The hip is medially rotated, and the snap buckle is attached to the D-ring provided on the medial aspect of the stirrup.

Exercise: The exercise is performed by laterally rotating the hip against the resistance provided by the table's pulley arrangement.

Note: Unless the subject is tall enough to rest the leg comfortably

on the table, this exercise should not be performed. To exercise the lateral rotators of the right hip, the same procedures are followed except the subject assumes the standing at the side of the table and facing it, with the weight pan on his right.

Knee Extensor Exercises

I. Knee Extensor Exercise: Supine

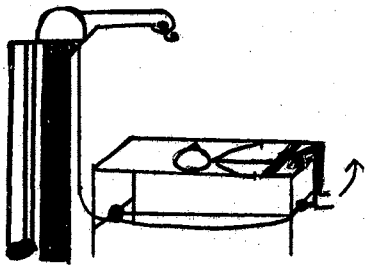

Figure 71

Table: The special pulley assembly is attached for utilization as previously described in Chapter IV on page 50. The appropriate weight is placed on the weight pan.

Subject: After the foot stirrup has been attached to the foot, the subject assumes a supine position on the table with the lower leg and distal one-third of the thigh extended beyond the table's edge. The thigh rest may be placed under the thigh on the table top to allow a greater range of movement in the knee. The thigh should be stabilized to the table by utilizing the straps across the thighs and iliac crest. The knee to be exercised should be flexed to 90 degrees. If needed, a long boot strap may be utilized to assist in holding the non-exercising lower leg in a flexed position parallel to the table's leg. The snap buckle of the assembly is attached to the D-ring at the heel of the foot stirrup.

Exercise: The exercise is performed by extending the knee against the resistance offered by the table's pulley arrangement.

Note: The exercise range should be 90 degrees.

II. Knee Extensor Exercise: Prone

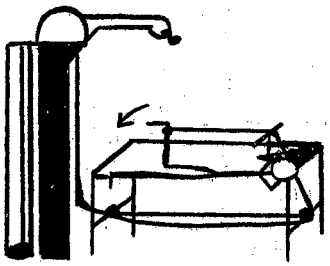

Figure 72

Table: The special pulley assembly, bar, and directional pulley wheel are attached for operation as previously described on pages 50 and 58. The exact location, height, and angle of the bar will be determined by the individual needs of the subject performing the exercise. For the experimenter's purposes, the bar was positioned at the end of the excursion area near the center of the table. The angle of the bar was 90 degrees while the height was approximately 1 foot. A supplementary cable is attached to the assembly's snap buckle, passed through the excursion area and over the directional pulley. The appropriate weight is placed on the weight pan.

Subject: After the foot stirrup has been firmly affixed, the subject assumes a prone position on the table with his head at the foot-end. This position on the table must be off-center in the direction opposite that of the knee to be exercised (i.e., on the right half of the table if the left knee is to be exercised). The knees are positioned so that they are 1 to 2 feet closer to the head-end of the table than is the bar. The table's strap is positioned across the subject's thighs, close to the knees. The knee to be exercised is flexed to 90 degrees in front of the bar. The arms may be used to stabilize the

body by grasping the table's edge. Prior to the exercise, the cable snap buckle is attached to the D-ring at the heel of the stirrup.

Exercise: The exercise is performed by extending the knee against the resistance offered by the table's pulley arrangement.

Note: The exercise range should be 90 degrees.

Knee Flexor Exercises

I. Knee Flexor Exercise: Prone

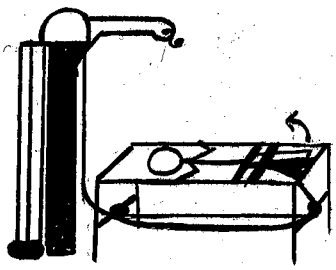

Figure 73

Table: The special pulley assembly is attached for operation as previously described on page 50. The appropriate weight is attached to the weight pan.

Subject: After the ankle cuff or foot stirrup has been securely attached, the subject assumes a prone position on the table with the cuff above the boot carriage excursion area. Stabilization is made by attaching the table's straps across the subject's thigh just above the knee and at the iliac crest. The hands are placed on the table's edge for support. The knee to be exercised is extended to a position resting on the table top. The ankle is dorsi-flexed if the gastrocnemius is to be exercised and plantar-flexed if only the hamstrings are to be exercised. The snap buckle of the cable is attached to the D-ring on the ankle cuff just in front of the ankle.

Exercise: The exercise is performed by flexing the knee against

the resistance offered by the table's pulley arrangement.

II. Knee Flexor Exercise: Prone

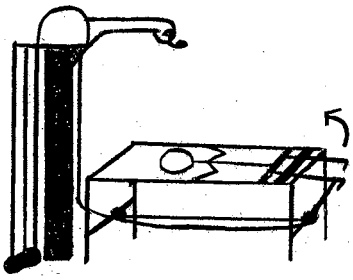

Figure 74

Table: The special pulley arrangement is attached for utilization as previously described on page 50. The appropriate weight is attached to the weight pan.

Subject: After the ankle cuff has been securely attached, the subject assumes a prone position on the table with the lower leg extended beyond the foot-end of the table. The hands are placed on the table's edge for support. The knee being exercised is extended. The ankle is dorsi-flexed if the gastrocnemius is to be exercised and plantar-flexed if only the hamstrings are to be exercised. Stabilization should be made above the knee and at the iliac crest. The snap buckle from the assembly is attached to the D-ring positioned on the anterior portion of the ankle.

Exercise: The exercise is performed by flexing the knee against the resistance offered by the table's pulley arrangement.

Note: The exercise range should be approximately 125 degrees.

Ankle Dorsi-Flexion Exercises

I. Ankle Dorsi-Flexion Exercise: Sitting

Table: The special pulley assembly is attached for use as described on page 50. The appropriate weight is placed on the weight

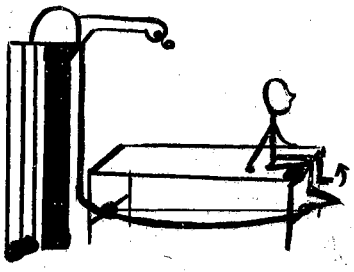

Figure 75

pan.

Subject: After the boot with the toe extension is attached to the foot, the subject assumes a sitting position on the foot-end of the table. The knee is flexed to 90 degrees and extended beyond the table's edge approximately 1 to 2 inches. This position of the knee should be maintained throughout the exercise. The thigh rest is placed under the thigh close to the knee. Stabilization at the thighs may be necessary. The arms are positioned at the sides of the table for support. The starting position is with the ankle plantar flexed. The snap buckle is attached to the toe extension on the boot.

Exercise: The exercise is performed by dorsi-flexing the ankle against the resistance provided by the table's pulley arrangement. Inversion and eversion should be avoided.

II. Ankle Dorsi-Flexion Exercise: Supine

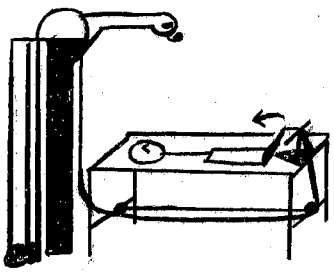

Figure 76

Table: The special pulley assembly, bar, and directional pulley wheel are attached for operation as described on page 50. The bar should be perpendicular to the table top and elevated 1 1/2 feet above the table. The bar should be positioned and stabilized

10 inches from the foot-end of the excursion area. The special pulley assembly's snap buckle is passed through the carriage excursion area and over the directional pulley wheel. The appropriate weight is applied to the weight pan.

Subject: The boot with the toe extension is attached to the subject's foot. The subject assumes a supine position on the table with the ankle to be exercised 2 to 3 inches in front of the bar and directional pulley wheel. The arms are used to stabilize the body. The hip and knee are extended and must be maintained in this position throughout the exercise. Stabilization below the knee may be necessary. Prior to the exercise, the ankle is plantar flexed; and the snap buckle is attached to the slot provided on the toe extension.

Exercise: The exercise is performed by dorsi-flexing the ankle against the resistance offered by the table's pulley arrangement. Inversion and eversion should be avoided.

Ankle Plantar-Flexion Exercises

I. Ankle Plantar-Flexion Exercise: Supine

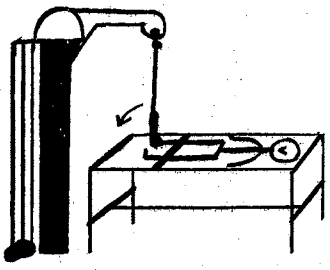

Figure 77

Table: The overhead pulley is attached for operation as previously described on page 46. The appropriate weight is placed on the weight pan.

Subject: After the boot with the toe extension has been attached, the subject assumes a supine position on the table top with the

ankle to be exercised directly below the overhead pulley. The arms are used to stabilize the body. The hip and knee are extended and should be maintained in this position throughout the exercise. Stabilization is necessary at the knee. Prior to the exercise, the ankle is dorsi-flexed and the snap buckle is attached to the slot provided on the toe's extension.

Exercise: The exercise is performed by plantar-flexing the ankle against the resistance provided by the table's pulley arrangement. Inversion and eversion should be avoided.

II. Ankle Plantar-Flexion Exercise: Sitting

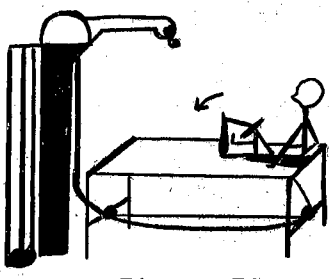

Figure 78

Table: The special pulley assembly, bar, and directional pulley wheel are attached for use as described on pages 50 and 58. The bar is placed at a height of 1 to 1 1/2 feet, at a 90-degree angle and at the end of the excursion area near the center of the table. The supplementary cable is attached to the snap buckle, passed through the boot carriage excursion area and over the directional pulley wheel. The appropriate weight is placed on the weight pan.

Subject: After the boot with the toe extension has been attached, the subject assumes a long sitting position on the foot-end of the table facing the bar. This position on the table must be off-center in the direction opposite that of the ankle to be exercised. The

ankles are positioned at least 3 inches in front of the bar. The arms are placed on the table top for support. The hip and knee are extended and may need to be stabilized. Prior to the exercise, the ankle is dorsi-flexed, and the snap buckle is attached to the slot provided on the toe extension of the boot.

Exercise: The exercise is performed by plantar-flexing the ankle against the resistance offered by the table's pulley arrangement. Inversion and eversion should be avoided.

Ankle Inversion Exercises

I. Ankle Inversion Exercise: Sitting

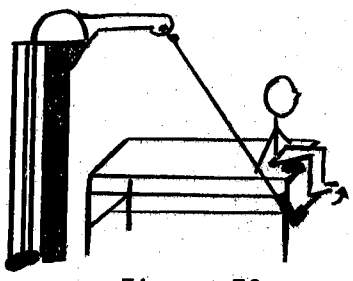

Figure 79

Table: The hip rotator attachment is attached for use as previously described on page 50. The position of the attachment's pulley on the swivel head will be dependent upon the length of the subject's lower leg. The appropriate weight is placed on the weight pan.

Subject: The foot stirrup or drilled boot is placed on the subject's foot. The subject assumes a correct sitting position on the foot-end of the table top. The knee is flexed to 90 degrees and extended beyond the table's edge approximately 1 to 2 inches. The thigh rest is placed under the thigh close to the knee. Stabilization above the knee may be necessary. The hands are placed on the table top for support. The ankle is locked in dorsi-flexion and should be maintained

in this position throughout the exercise. The snap buckle from the pulley closest to the ankle to be exercised is attached to the D-ring on the bottom of the foot stirrup.

Exercise: The exercise is performed by inverting the ankle against the resistance offered by the table's pulley assembly.

II. Ankle Inversion Exercise: Supine

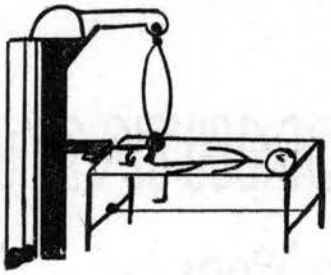

Figure 80

Table: The hip abductor assembly is attached to the overhead pulley and locked into position according to the instructions presented in Chapter IV, page 47. The appropriate weight is placed on the weight pan.

Subject: The foot stirrup or drilled boot is attached to the subject's ankle. The subject assumes a supine position on the table with the ankles to the left of the pulley assembly. The arms are used to stabilize the body. The leg nearest the table's edge is flexed at the knee and hung off the table's edge. The ankle to be exercised is locked in dorsi-flexion and should be maintained in this position throughout the exercise. Stabilization may be necessary both below and above the knee. The cable's snap buckle closest to the ankle to be exercised is attached to the D-ring on the bottom of the stirrup.

Exercise: The exercise is performed by inverting the ankle against the resistance provided by the table's pulley arrangement.

Ankle Eversion Exercises

I. Ankle Eversion Exercise: Sitting

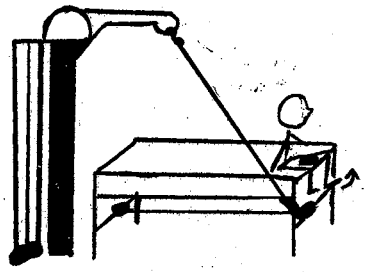

Figure 81

Table: The hip rotator attachment is attached for use as previously described on page 50. The position of the attachment's swivel head will be dependent upon the length of the subject's lower leg. The appropriate weight is placed on the weight pan.

Subject: The foot stirrup or drilled boot is placed on the subject's foot. The subject assumes a sitting position on the foot-end of the table. The knee is flexed 90 degrees and extended beyond the table's edge approximately 1 to 2 inches. The thigh rest is placed under the thigh close to the knee. Stabilization above the knee may be necessary. The hands are placed on the table's top for support. The ankle is locked in dorsi-flexion and should be maintained in this position throughout the exercise. The snap buckle from the pulley fartherest from the ankle to be exercised is attached to the D-ring on the bottom of the foot stirrup.

Exercise: The exercise is performed by everting the ankle against the resistance offered by the table's pulley assembly.

II. Ankle Eversion Exercise: Supine

Table: The hip abductor assembly is attached to the overhead

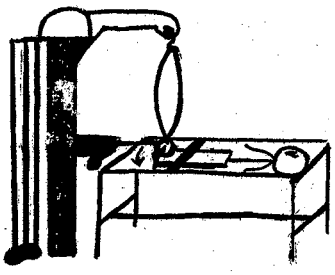

Figure 82

pulley and locked into position above the table as described on page 47. The appropriate weights are placed on the weight pan.

Subject: The foot stirrup or drilled boot is attached to the subject's ankle. The subject assumes a supine position on the table with the legs straddling the pulley assembly. The arms may be utilized to stabilize the body. The ankle to be exercised is locked into dorsi-flexion and should be maintained in this position throughout the exercise. Stabilization is necessary below the knee. The cable's snap buckle closest to the ankle to be exercised is attached to the D-ring on the bottom of the stirrup.

Exercise: The exercise is performed by everting the ankle against the resistance provided by the table's pulley arrangement.

CHAPTER VI

SUMMARY AND RECOMMENDATIONS

This study was undertaken in an effort to develop a more useful manual for the operation of the Elgin Exercise Table. The material presented was compiled after a survey of the literature pertaining to progressive resistance exercise, progressive resistance exercise equipment, and the Elgin Exercise Table.

In an attempt to provide background information concerning the proper operation of the Elgin Exercise Table, the objectives, principles, techniques, and hazards of progressive resistance exercise were presented. DeLorme's initial and subsequent exercise programs, and their modifications were reviewed to provide information on the proper operation of the Elgin Exercise Table and the organization and administration of an exercise program designed to develop muscular strength.

Since the investigation of the manufacturer's specifications and the literature revealed a lack of information concerning the operation and effectiveness of the Elgin Exercise Table, a search was made for information on other progressive resistance exercise equipment. A study was made of the benefits and values of the other equipment in an attempt to gain more insight into the use of the Elgin Exercise Table. The Elgin Exercise Table was explored through experimentation with and without subjects. The procedures for operating the table and the various supplementary accessories and attachments were determined and

described.

Seventy-six exercises were devised through anatomical and kinesiological analyses. Two exercises for each of the major joint actions were devised on the basis of fourteen criteria.

In the writer's opinion, the Elgin Exercise Table has potential as a progressive resistance exercise apparatus in the physical education programs of today's schools and colleges where corrective or adapted programs exist. It would seem to have unlimited possibilities for exercising specific muscle groups needing strengthening. It provides an accurate method of evaluating exercises in which the exercise load, position of the subject, and the range of motion through which the joint is moved can be accurately controlled. The versatility of the table can provide a wider variety of exercises thereby decreasing the monotony of one established exercise pattern.

If the desired results are to be realized, the exercise program must be accurately controlled and administered. Since the Elgin Exercise Table has been designed and developed especially to meet these requirements, it is felt that the unit could help to eliminate the necessity of constantly improvising apparatus for use in the body mechanics, correctives, and adapted physical education programs.

Recommendations for Further Study

Today there is considerable disagreement in the anatomical literature regarding the specific action of individual muscles in the human body. "It is an established fact that muscles do not always participate in the actions which their contractions could aid; therefore, it is accurate to speak only of the actions of muscle groups, and not of

individual muscles" (8:236). This fact results in the need for kinesiological and electromyographical studies of the actions of specific muscles during certain activities. These studies could do much to substantiate or disprove our theories of muscle function and exercise.

For example, in performing the "sit-up" exercise, to what extent do the lower abdominals, the upper abdominals, or both participate in the movement which occurs? Should a different exercise be designed to strengthen the lower abdominals? A movie camera or a sequential movement camera might be used in conjunction with the EMG apparatus to show at what point in the exercise the action potentials occur. Research into the muscle function and the exercise itself might possibly result in evidence that the muscles are not strengthened as effectively in our "standard exercise" as we have believed, and that some other exercise arrangement would be more efficient.

This research, if it is to be accurate, must be precise and conducted as carefully as possible with objective tools. Perhaps the Elgin Exercise Table can serve as a tool to aid the researcher in conducting a better controlled, more accurate study.

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APPENDIX

523-0414
523-0615

THOMAS L. DELORME, M.D.
WARREN BUILDING
275 CHARLES STREET
BOSTON, MASSACHUSETTS 02114

MASSACHUSETTS GENERAL HOSPITAL

April 11, 1970

Miss Mary Jess Tibbels
Colvin Physical Education Center
Oklahoma State Univesity
Stillwater, Oklahoma

Dear Miss Tibbels:

Please forgive my delay in not answering your letter earlier but I have been out of the country a great deal in the past two months.

My interest and work in progressive resistance exercises began back at the Gardner General Hospital in Chicago, Illinois in 1944. It was while I was stationed at the Gardner General Hospital fresh out of internship that I was assigned to an orthopedic ward, where patients who had received their maximum benefits from hospitalization were gathered prior to their either being discharged from the Service or being sent to a rehabilitation center. Oftentimes these men were on the ward for a period of one to three months awaiting disposition. I was responsible for doing their discharge examinations, and as I examined them I became acutely aware of the residual atrophy and stiffness that most of them had in the involved joints.

Having at the age of fourteen a long-drawn out chronic illness, I became interested in different types of strength exercises and have ever since that time been involved in actual participation, research, and writing about exercises, chiefly the resistance type. Therefore by the time I had become involved in orthopedic work in the army, I had already been engaged in weight lifting exercises for a period of approximately ten years. I saw no reason why from a physiological or pathological point of view that progressive resistance exercises could not be applied in patients with certain medical and surgical disorders. It was at the Gardner General Hospital that I undertook a program of investigation to assess the effectiveness of PRE in different conditions. In order to exercise painful stiff and unstable joints, one could of course not use routine athletic equipment. This inspired me to develop equipment adaptable to patient use. Therefore with the help of the hospital engineers and maintenance crews, all the original progressive resistance exercise equipment used at that time was constructed under my supervision.

During this period of developing the techniques of PRE and building the equipment, several people became interested in manufacturing the equipment for commercial purposes. One of them was actually a patient at the Gardner General Hospital at that time. This patient lived in Elgin, Illinois, and in 1945 I decided to let him manufacture the equipment. He therefore formed the Elgin Exercise Appliance Company and took over the manufacture of the equipment in Elgin upon his discharge from the hospital in 1945. Mr. Gannon, the man referred to above, since that time has owned and directed the Elgin Exercise Appliance Company, and I have worked with him in the design of equipment over the years.

April 11, 1970

In the first two or three years of manufacturing the equipment, the designs changed rapidly. Initially we built separate devices for each joint, in other words we had one table just for quadriceps exercise, another stand for hip exercises, a rack type of affair for back exercises, and a tilted board for abdominal exercises. There was a table designed for certain shoulder and hand exercises. As time went along it became obvious that six or eight pieces of equipment occupied too much space and it was neither economical or functionally optimum. Therefore we attempted to bring most of the exercises done on the individual pieces of equipment into one large piece of equipment. This resulted in the Elgin Table to which you referred in your letter.

The first Elgin Table was sold commercially, as best I can remember, in 1946.

I came to the Massachusetts General Hospital in 1946 and did the work on progressive resistance exercises in poliomyelitis, muscular dystrophy, and other types of diseases and injuries. I did work in this area for two or three years and then went back into orthopedic surgery.

I still am involved in certain research projects dealing with exercise and testing techniques but more at the laboratory than at the clinical level. If it would be of any interest to you, I could send you some photographs of the first PRE equipment used for clinical purposes. I think I have somewhere slides or photographs of the equipment used at the Gardner General Hospital in 1944, 45, and 46.

There are approximately 100 exercises that can be done on the Elgin Table. I found over the years that most people who use the table really don't appreciate the wide variety of exercises possible. The book I published with Dr. Watkins to which you referred in your letter shows quite a large number of these exercises.

The chief factors with which we were concerned in the construction of the Elgin Table were those dealing with the older age groups with complicating factors, such as cardiovascular disease, hernias, hypertension, etc. The table had to provide not only a wide range of activities but also permit these exercises to be done in a very safe fashion. The table also had to include enough flexibility to permit one to exercise most of the major joints throughout the full or partial range of motion against most any resistance required. Another factor built into the table was that auto-assistive exercises had to be considered. Oftentimes the patients, as you well recognize, cannot operate against gravity, so much of the planning was done to allow assistance as well as resistance in the performance of exercises.

I hope this information is of the type for which you are looking. If not, I would be happy to cooperate in any way I can.

Thank you once again for your interest in our equipment and techniques.

Sincerely yours,

Thomas L. DeLorme

Thomas L. DeLorme, M. D.

TLD/rt

VITA

Mary Jess Tibbels

Master of Science

Thesis: AN INSTRUCTIONAL MANUAL FOR USE OF THE ELGIN EXERCISE TABLE

Major Field: Health, Physical Education and Recreation

Biographical:

Personal Data: Born in Little Rock, Arkansas, January 10, 1943, the daughter of W. O. and Jeannette Tibbels.

Education: Attended elementary school in Russellville, Arkansas; graduated from Russellville High School in 1961; received the Bachelor of Science degree from Arkansas Polytechnic College, Russellville, Arkansas, with a major in Health, Physical Education, and Recreation, in May, 1965; completed the requirements for the Master of Science degree in July, 1970.

Professional Experience: In 1965, was a secondary teacher in the Lake Ozark, Missouri Public School System; during the school terms of 1968-70, was a Graduate Assistant in the Health, Physical Education and Recreation Department at the Oklahoma State University.

Professional Organizations: Oklahoma Association of Health, Physical Education and Recreation; American Association of Health, Physical Education and Recreation; National Education Association; Oklahoma Education Association.