



I

**A COMPARISON BETWEEN THE EFFECTS OF LAND AND
WATER BASED EXERCISES IN PATIENTS WITH RHEUMATOID
ARTHRITIS**

by

Kim Nolte

Submitted in fulfillment of the requirements for the degree

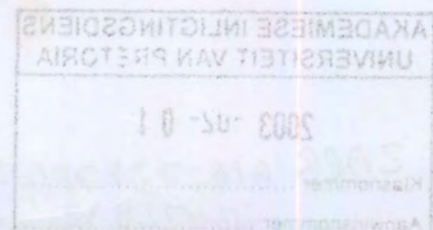
Magister Artium (HMS)

in the

**Faculty of Humanities
Department of Biokinetics, Sport and Leisure Sciences**

University of Pretoria

Pretoria, February, 2002





DEDICATION

THIS DISSERTATION IS DEDICATED TO ALL RHEUMATOID ARTHRITIS SUFFERERS



III

ACKNOWLEDGEMENTS

I WOULD LIKE TO EXPRESS MY SINCERE THANKS AND GRATITUDE TO THE FOLLOWING PERSONS AND INSTITUTIONS FOR THEIR GUIDANCE, WITHOUT WHO'S ASSISTANCE, THIS STUDY WOULD NOT HAVE BEEN POSSIBLE.

PROFESSOR P E KRUGER, (DEPARTMENT OF BIOKINETICS, SPORT & LEISURE SCIENCES, UNIVERSITY OF PRETORIA), WHO ACTED AS MY PROMOTER. FOR HIS TIME, SUPPORT AND GUIDANCE.

DR C JANSE VAN RENSBURG, (DEPARTMENT OF SPORTS MEDICINE, UNIVERSITY OF PRETORIA), WHO ACTED AS MY CO-PROMOTER. FOR HER ENTHUSIASM, SUPPORT, GUIDANCE AND ASSISTANCE WITH EVALUATIONS.

A M VAN DER MERWE, (INSTITUTE OF PATHOLOGY, UNIVERSITY OF PRETORIA), FOR THE ANALYSIS OF BLOOD SAMPLES.

HEINRICH NOLTE, (MY HUSBAND). FOR HIS LOVE, PATIENCE, SUPPORT AND GENERAL ASSISTANCE.

YVONNE DE'ATH, (MY MOTHER). FOR HER SUPPORT, UNCONDITIONAL LOVE AND GENERAL ASSISTANCE.

SUBJECTS WHOM PARTICIPATED IN THE STUDY: FOR THEIR TIME, SUPPORT AND WILLINGNESS IN ASSISTING ME.

NATIONAL RESEARCH FOUNDATION: THEIR FINANCIAL ASSISTANCE TOWARDS THIS RESEARCH IS HEREBY ACKNOWLEDGED. OPINIONS EXPRESSED AND CONCLUSIONS ARRIVED AT, ARE THOSE OF THE AUTHOR AND ARE NOT NECESSARILY TO BE ATTRIBUTED TO THE NATIONAL RESEARCH FOUNDATION.

INSTITUTE FOR SPORTS RESEARCH, UNIVERSITY OF PRETORIA: THE USE OF THEIR EQUIPMENT IN THE EVALUATIONS OF THE SUBJECTS AND EXERCISE PROGRAMMES.

CHRISTINE SMITH: ASSISTANCE WITH THE ANALYSIS OF STATISTICAL DATA.

JACOB MAKAFULA: FOR THE TRANSPORT OF BLOOD SAMPLES.

IV

Synopsis

Title	A comparison between the effects of land and water based exercises in patients with Rheumatoid Arthritis
Candidate	Kim Nolte
Promoter	Prof. PE Krüger
Co-Promoter	Dr C Janse van Rensburg
Degree	MA (HMS)

Rheumatoid Arthritis (RA) is the most common type of chronic inflammatory arthritis (Thompson, 1998). When appropriately prescribed, therapeutic exercise is useful in the care of patients with RA (Semble et al., 1990).

A pre-test - post-test randomized groups design was adopted for the study to compare the effects of a land- and water-based exercise programme in RA patients. A total of ten subjects, diagnosed with RA functional class I or II according to Steinbrocker, were assigned to either a group performing water-based exercises (W, n=4), a group performing land-based exercises (L, n=4), or a control group, who were requested to continue with their present sedentary lifestyle (C, n=2). For inclusion in the study, subjects were required to be on stable medication. Categories of dependent variables measured, were disease activity, haematology, functional and psychological status as well as physical status.

There was a reduction in total swollen and tender joint counts in both experimental groups, but not the control group. The reduction was greater in group W than group L. Total tender joint count (TJC) decreased by 53% ($p < 0.10$) and the total swollen joint count (SJC) decreased by 31% ($p > 0.05$) in group W. In group L, the total TJC decreased by 4,7% ($p > 0.05$) and the total SJC decreased by 8,5% ($p > 0.05$).

V

The haematological values remained globally unchanged in all three groups concerning the hemoglobin (Hb) values.

There were changes in the erythrocyte sedimentation rate (ESR) in the groups, however changes were not significant ($p>0.05$). The ESR decreased by 29% in group W and by 33% in group C. There was a slight increase in group L's ESR (11,9%) but values remained within the normal range.

There was an improvement in the patients self-assessed disability and psychological status in the experimental groups while there was a deterioration in the control group's. Health Assessment Questionnaire (HAQ) scores improved by 15% in group W ($p>0.05$), 18% in group L ($p>0.05$) and deteriorated by 13% in group C ($p>0.05$). There was no change in the total Profile of Mood States (POMS) score of the control group, however, significant ($p<0.05$) improvements were observed in the experimental groups. There was a 163% improvement in group L's and a 99% improvement in group W's affective states.

As far as physical condition is concerned, in general, there was an improvement in group W and group L's physical condition, while there was no improvements noted in group C.

Group W showed the following changes in physical condition :

Body mass decreased by 9,2% ($p>0.05$). Mean blood pressure values remained unchanged. 50-ft walk time improved by 18% ($p<0.05$). Right and left grip strength increased by 18% and 35% respectively, ($p<0.05$). Absolute VO_2 max increased by 28% and relative VO_2 max increased by 30% ($p<0.05$). Right knee flexor strength increased by 43% ($p<0.05$) and left knee flexor strength by 24% ($p>0.05$). Increases in right and left knee extensor strength were 32% ($p>0.05$) and 34% ($p>0.05$) respectively. Improvement in joint mobility was also noted. There was a significant ($p<0.05$) improvement in both right and left wrist extension range of motion(ROM). Right wrist extension ROM improved by 49% and left wrist extension ROM improved by 31%. Improvements were also noted in wrist flexion ROM however changes were not significant ($p>0.05$). There was an 12% and 19% increase in right and left wrist flexion ROM respectively. In

VI

addition, there was a 12% ($p<0.05$) increase in right knee flexion ROM and a 14% increase in left knee flexion ROM ($p<0.05$).

Group L showed the following changes in physical condition :

Mean body mass and blood pressure remained unchanged. 50-ft walk test time improved by 15% ($p<0.05$). Right and left grip strength increased by 4,8% and 16.1% respectively ($p>0.05$). Relative VO_2 max increased by 16.6% and absolute VO_2 max by 31% ($p<0.05$). Right knee flexor strength increased by 22.1% and left knee flexor strength by 23.8% ($p>0.05$). Increase in right and left knee extensor strength was 9% and 2,4% respectively ($p>0.05$). Right wrist extension ROM increased by 20.7% and left wrist extension ROM increased by 15,7% ($p>0.05$). There was a significant ($p<0.05$) increase in left wrist flexion (7,6%), but right wrist flexion ROM decreased by 2.6% ($P>0.05$). Improvements in right and left knee flexion ROM were also significant ($p<0.05$), 9,2% and 7,4%, respectively.

Group C showed the following changes in physical condition :

Mean body mass increased by 2% ($p>0.05$), while blood pressure and 50-ft walk time remained globally unchanged. Left grip strength decreased by 16% ($p>0.05$) and right grip strength remained the same. Although not significant ($p>0.05$), there was a 11% decrease in relative VO_2 max and a 6,7% decrease in absolute VO_2 max. Muscle strength also showed deterioration in group C. Right and left knee flexor strength decreased by 1,8% and 12%, respectively ($p>0.05$). Left knee extensor strength remained unchanged while right knee extensor strength decreased by 9,7% ($p>0.05$). Right wrist extension ROM decreased by 4.7% and left wrist extension ROM increased by 6.7%, although the increase was not significant ($p>0.05$). While right wrist flexion ROM decreased by 1,3% and left wrist flexion ROM decreased by 21% ($p>0.05$). There were no significant ($p>0.05$) changes in group C's right and left knee flexion ROM. Right knee flexion ROM decreased by 1,2% and left knee flexion ROM increased by 1,2%.

Based on the above results of the study, both exercise interventions are beneficial in the treatment of RA. Appropriate land-based exercises do not appear to enhance disease

VII

activity, however, the water-based exercise programme was superior in controlling the disease activity. Further research is required, using larger samples and evaluating the long-term effects of various exercise interventions.

Key Words: Rheumatoid Arthritis, Exercise Therapy, Rehabilitation, Water-based Exercises, Land-based Exercises



VIII

Sinopsis

Titel	'n Vergelyking tussen die effek van land en water gebaseerde oefeninge in pasiente met Rheumatoïde Arthritis
Kandidaat	Kim Nolte
Promotor	Prof. PE Krüger
Mede-Promotor	Dr C Janse van Rensburg
Graad	MA (MBK)

Rheumatoïde Arthritis (RA) is die mees algemeenste tipe kroniese inflammatoriese artritis (Thompson, 1998). Indien dit korrek voorgeskryf word, kan terapeutiese oefeninge waardevol wees in die behandeling van pasiente met RA (Semble, et al., 1990).

'n Voortoets – natoets lukraak toegewysde groepsontwerp is aangewend tydens die studie, met die doel om 'n vergelyking te tref tussen die gevolge van 'n land- en water-gebaseerde oefenprogram vir RA pasiente. 'n Totaal van tien probante, gediagnoseer met RA funksionele klas I of II (volgens die Steinbrocker klassifikasie stelsel) is toegewys na onderskeidelik 'n groep wat water-gebaseerde oefeninge doen (W, n = 4), 'n groep wat land-gebaseerde oefeninge doen (L, n = 4), en 'n kontrole groep wie gevra is om voort te gaan met hul huidige sedentêre lewensstyl. Vir toelating tot die studie is vereis dat proefpersone op stabiele medikasie was. Kategorieë van afhanklike veranderlikes wat gemeet is, sluit in siekte-aktiwiteit, hematologie, funksionele en psigologiese status so wel as fisieke status.

Daar was 'n afname in die totale geswelde,-en teer-gewrig tellings in beide eksperimentele groepe, maar geen verskil in die kontrole groep nie. Die afname was egter groter in groep W as in groep L. In groep W het die totale-teer-gewrigs telling (TJC) met 53% ($p < 0.10$) en die totale geswelde-gewrigs-telling (SJC) met 31% ($p > 0.05$) onderskeidelik afgeneem. In groep L het die totale TJC afgeneem met 4,7% ($p > 0.05$), en die totale SJC met 8,5% ($p > 0.05$).

IX

Die hematologie waardes het geen veranderings getoon vir enige van die drie groepe nie met die betrekking tot die hemoglobien. Daar was wel veranderinge in die groepe se eretroset sedimentasie tempo (ESR), maar hierdie veranderinge was onbeduidend ($p>0.05$). Die ESR het afgeneem met 29% in groep W en met 33% in groep C. Daar was a klein toename in groep L se ESR (11,9%), maar die waardes het binne die normale reikwydtes gebly.

Daar was 'n verbetering in die pasiente se self-geassesseerde gestremtheid en psigologiese status in die eksperimentele groepe, terwyl daar 'n afname was in die kontrolegroep. Die Gesondheids Evaluerings Vraelys (HAQ) het 'n verbetering van 15% vir groep W getoon ($p>0.05$), 18% vir groep L ($p>0.05$) en 'n negatiewe verandering van 13% vir groep C ($p>0.05$). Daar was geen veranderinge in die totale gemoedstoestand profile (POMS) vir groep C nie, maar wel beduidende ($p<0.05$) verbeteringe vir die eksperimentele groepe met onderskeidelik 163% en 99% vir groepe L en W onderskeidelik.

Beide groepe L en W het in die algemeen verbeterings in hul fisieke kondisionering getoon, terwyl daar geen verbetering in groep C voorgekom het nie.

Groep W het die volgende veranderinge in hul fisieke kondisionering getoon :

Liggaamsmassa het met 9,2% ($p>0.05$) afgeneem, terwyl gemiddelde bloeddruk onverandered gebly. Die 50-voet looptoets se tyd het met 18% ($p<0.05$) verbeter. Beide regs en linker greepkrag het met onderskeidelik 18% en 35% ($p<0.05$) verbeter. Absolute VO_2 max het met 28%, en relatiewe VO_2 max het met 30% toegeneem ($p<0.05$). Regter knie fleksorkrag het met 43% verbeter ($p>0.05$) en die linker knie fleksorkrag met 24% ($p>0.05$). Toenames in regter- en linker knie ekstensorkrag was 32% ($p>0.05$) en 34% ($p>0.05$) onderskeidelik. Verder was daar ook verbeteringe in gewrigsomvang. Daar was beduidende verbeterings ($p<0.05$) in beide regter en linker gewrigsekstensie bewegingsomvang. Die regter en linker gewrig het verbeterings van onderskeidelik 49% en 31% vertoon. Die verbeteringe van onderskeidelik 12% en 19% vir die regter en linker gewrigs-fleksie was egter nie beduidend nie ($p>0.05$). Verder was daar beduidende

X

($p < 0.05$) verskille van 12% en 14% onderskeidelik vir toenames in regter en linker knie fleksie bewegingsomvang.

Groep L het die volgende veranderinge in hul kondisionering getoon:

Gemiddelde liggaamsmassa en bloeddruk het onveranderd gebly. Die 50-voet looptoets se tyd het met 15% ($p < 0.05$) verbeter. Die regter en linker greepkrag het met onderskeidelik 4,8% en 16,1% ($p > 0.05$) verbeter. Relatiewe VO_2 max het met 16,6% toegeneem, terwyl die absolute VO_2 max 'n toename van 31% getoon het ($p < 0.05$). Regte knie fleksorkrag het met 22,1% en linker knie fleksorkrag met 24% ($p > 0.05$) toegeneem. Toenames in regter en linker knie ekstensorkrag was onderskeidelik 9% en 2,4% ($p > 0.05$). Die toenames in regter- en linker gewrigs ekstensie bewegingsomvang was 20,7% en 15,7% ($p > 0.05$) onderskeidelik. Daar was 'n beduidende toename in linker gewrigs-fleksie van 7,6% ($p < 0.05$), maar regs was daar 'n afname van 2,6% ($p > 0.05$) in die bewegingsomvang. Verbeterings in beide die regter en linker knie-fleksie bewegingsomvang was beduidend ($p > 0.05$) met 9,2% en 7,4% onderskeidelik.

Groep C se veranderinge in kondisionering was as volgs:

Gemiddelde liggaamsmassa het toegeneem met 2% ($p > 0.05$). Beide die bloeddruk en tyd van die 50-voetlooptoets het onveranderd gebly. Die linker greepkrag het met 16% ($p > 0.05$) afgeneem, terwyl die regter greepkrag onveranderd gebly het. Alhoewel nie beduidend nie ($p > 0.05$), was daar 'n 11% afname in relatiewe VO_2 max en 'n 6,7% afname in absolute VO_2 max. Spierkrag het ook afnames getoon in groep C. Regter- en linker- knie fleksorkrag het met onderskeidelik 1,8% en 12% afgeneem ($p > 0.05$). Linker knie ekstensorkrag het onveranderd gebly, terwyl die regterbeen se waardes afgeneem het met 9,7% ($p > 0.05$). Regtegewrigsektensie omvang het met 4,7% afgeneem en linkegewrigsektensie omvang het met 6,7% toegeneem ($p > 0.05$). Regtegewrigsfleksie omvang het met 1,3% afgeneem, terwyl linkegewrigsfleksie met 21% afgeneem het ($p > 0.05$). Daar was geen beduidende ($p > 0.05$) veranderinge in groep C se regter en linker knieg fleksie omvang nie, regter knie fleksie omvang het met 1,2% afgeneem en linker knie fleksie omvang het met 1,2% verbeter.

XI

Na aanleiding van die studie se resultate is beide intervensies (water- en land-gebaseerde oefeninge) voordelig in die behandeling van RA. Korrekte land-gebaseerde oefeninge blyk nie die toestand van RA te vererger nie, maar die waterterapie (hidroterapie) was meer doeltreffend in die beheer van die siektetoestand. Verdere navorsing met groter populasies is egter nodig om die langtermyn gevolge van verskeie oefeningsintervensies te evalueer.

Sleutelwoorde: Rheumatoïde Artritis, Oefeningsterapie, Rehabilitasie, Water-gebaseerde oefeninge; land-gebaseerde oefeninge



XII

**CHAPTER ONE
THE PROBLEM**



**CHAPTER TWO
LITERATURE REVIEW**



**CHAPTER THREE
METHODS & PROCEDURES**



**CHAPTER FOUR
RESULTS & DISCUSSIONS**



**CHAPTER FIVE
SUMMARY, CONCLUSIONS & RECOMMENDATIONS**



REFERENCES



APPENDICES



TABLE OF CONTENTS

	PAGE NO
TITLE PAGE	I
DEDICATION	II
ACKNOWLEDGEMENTS	III
SYNOPSIS	IV
SINOPSIS	VIII
TABLE OF CONTENTS	XIII
LIST OF FIGURES	XVI
LIST OF TABLES	XXI
LIST OF APPENDICES	XXII
<u>CHAPTER ONE: THE PROBLEM</u>	
1.1 INTRODUCTION	1
1.2 PROBLEM SETTING	3
1.3 PURPOSE AND AIM OF THE STUDY	4
1.4 HYPOTHESIS	4
<u>CHAPTER TWO: LITERATURE REVIEW</u>	
2.1 ARTICULATIONS/JOINTS	5
2.1.1 CLASSIFICATIONS OF JOINTS	6
2.1.1.1 IMMOBILE JOINTS (FIBROUS JOINTS/SYNARTHROSES)	6
2.1.1.2 SEMI-MOBILE JOINTS (CARTILAGINOUS JOINTS/AMPHIARTHROSES)	6
2.1.1.3 MOBILE JOINTS (SYNOVIAL JOINTS/DIARTHROSIS)	6
2.2 ARTHRITIS IN GENERAL	18
2.3 RHEUMATOID ARTHRITIS	18
2.3.1 GENERAL DEFINITION	18
2.3.2 HISTORY OF RA	19
2.3.3 EPIDEMIOLOGY OF RA	20
2.3.3.1 INCIDENCE AND PREVALENCE OF RA	20

XIV

2.3.4	PATHOGENESIS IN RA	23
	2.3.4.1 THE STAGES OF RA	24
	2.3.4.2 EXTRA-ARTICULAR DISEASE	30
2.3.5	CLINICAL MANIFESTATIONS OF RA	33
	2.3.5.1 PATTERNS OF ONSET	33
	2.3.5.2 JOINT MANIFESTATIONS OF RA	33
2.3.6	GENERAL MANAGEMENT OF RA	40
	2.3.6.1 MEDICAL MANAGEMENT	40
	2.3.6.2 ALTERNATIVE AND COMPLEMENTARY THERAPIES	41
	2.3.6.3 SURGICAL MANAGEMENT	42
	2.3.6.4 JOINT PROTECTION AND SPLINTING	44
	2.3.6.5 NUTRITION	46
	2.3.6.6 PHYSICAL THERAPY & EXERCISE	47
<u>CHAPTER THREE: METHODS & PROCEDURES</u>		
3.1	METHODS	89
	3.1.1 SUBJECTS	89
	3.1.2 EQUIPMENT	90
3.2	PROCEDURES	93
	3.2.1 CLINICAL ASSESSMENT	94
	3.2.2 LABORATORY ASSESSMENT	94
	3.2.3 PATIENTS ASSESSMENT	95
	3.2.4 FUNCTIONAL ASSESSMENT	96
3.3	EXERCISE PROGRAMMES	104
	3.3.1 LAND BASED EXERCISE PROGRAMME	104
	3.3.2 WATER BASED EXERCISE PROGRAMME	111



XV

3.4	RESEARCH DESIGN	115
3.5	STATISTICAL ANALYSIS	116
<u>CHAPTER FOUR : RESULTS & DISCUSSIONS</u>		
4.1	DISEASE ACTIVITY	119
4.2	HAEMOTOLOGY	122
4.3	ACTIVITIES OF DAILY LIVING AND PSYCHOLOGICAL STATUS	125
4.4	PHYSICAL CONDITION	129
<u>CHAPTER FIVE : SUMMARY, CONCLUSIONS & RECOMMENDATIONS</u>		148
<u>REFERENCES</u>		148
APPENDIX A		163
APPENDIX B		164
APPENDIX C		165
APPENDIX D		167
APPENDIX E		171
APPENDIX F		172



LIST OF FIGURES

FIGURE		PAGE
FIGURE 1:	LATERAL VIEW OF THE EXTENDED RIGHT KNEE AS SEEN IN PARASAGITTAL SECTION, SHOWING MAJOR ANATOMICAL FEATURES	5
FIGURE 2:	THE CRUCIAL COMPONENTS OF A DIATHRODIAL JOINT	7
FIGURE 3:	DIAGRAMME OF THE DEVELOPMENT OF A SYNOVIAL JOINT	8
FIGURE 4:	ILLUSTRATION OF THE REMODELING CYCLE IN MATURE BONE	10
FIGURE 5:	DIFFERENCES IN FUNCTION BETWEEN TYPE A CELLS AND TYPE B CELLS IN THE SYNOVIAL LINING ARE IMPLIED STRONGLY BY THEIR MORPHOLOGY IN THESE ELECTION PHOTOMICROGRAPHS	12
FIGURE 6:	THE BLACK CIRCLE REPRESENTS THE ONLY PART WITHIN A JOINT THAT IS NOT SURFACED BY SYNOVIUM OR ARTICULAR CARTILAGE	15
FIGURE 7:	SCHEMATIC REPRESENTATION OF THE STRUCTURE OF A FIBRIL OF TYPE 1 COLLAGEN	16
FIGURE 8:	THE EARLIEST CONVINCING REPRESENTATION IS SEEN IN THE PAINTING HANGING ABOVE THE STAIRS AT THE ROYAL NATIONAL HOSPITAL FOR RHEUMATIC DISEASES IN BATH	20
FIGURE 9:	AGE OF ONSET OF RA	21
FIGURE 10:	THE MAIN PATHOLOGICAL FEATURES OF RA	23
FIGURE 11:	NORMAL JOINT	24
FIGURE 12:	THE INFLAMMATORY TRIGGER MECHANISMS	26
FIGURE 13:	STAGE 2 RA	27
FIGURE 14:	STAGE 3 RA	28
FIGURE 15:	STAGE 4 RA	29
FIGURE 16:	STAGE 5 RA	30
FIGURE 17:	FREQUENCY OF RA IN THE VARIOUS JOINTS	34
FIGURE 18:	SWAN-NECK DEFORMITY	35
FIGURE 19:	BOUTONNIERE DEFORMITY	35
FIGURE 20:	ROENTENOGRAMS TAKEN AFTER IMPLANTION OF A SEMI-CONSTRAINED TOTAL JOINT PROSTHESIS DEMONSTRATING GOOD CORRECTION OF VARUS DEFORMITY	42

XVII

FIGURE 21:	RING SPLINT FOR BOUTONNIERE DEFORMITY PROHIBITS FLEXION OF PIP JOINT	46
FIGURE 22:	PAIN CYCLE	50
FIGURE 23:	EXAMPLE OF A RANGE-OF-MOTION EXERCISE	53
FIGURE 24:	(A) SHOULDER FLEXION AND (B) ABDUCTION USING OVERHEAD PULLEYS TO ASSIST THE MOTION	56
FIGURE 25:	EXAMPLE OF A STRENGTHENING EXERCISE	59
FIGURE 26:	EXAMPLE OF AN ISOMETRIC EXERCISE	60
FIGURE 27:	EXAMPLE OF AN ISOKINETIC EXERCISE	64
FIGURE 28:	EXAMPLE OF A FUNCTIONAL MASS MOVEMENT	65
FIGURE 29:	EXAMPLE OF A CARDIORESPIRATORY CONDITIONING EXERCISE	70
FIGURE 30:	EXERCISE PYRAMID	72
FIGURE 31:	HYDROTHERAPY FOR RA PATIENTS	73
FIGURE 32:	AN EXAMPLE OF A HAND EXERCISE	77
FIGURE 33:	AN EXAMPLE OF A WRIST EXERCISE	78
FIGURE 34:	AN EXAMPLE OF AN ELBOW EXERCISE	79
FIGURE 35:	AN EXAMPLE OF A SHOULDER EXERCISE	81
FIGURE 36:	AN EXAMPLE OF A HIP EXERCISE	82
FIGURE 37:	AN EXAMPLE OF A KNEE EXERCISE	83
FIGURE 38:	AN EXAMPLE OF AN ANKLE EXERCISE	84
FIGURE 39:	AN EXAMPLE OF A NECK EXERCISE	85
FIGURE 40:	HARPENDEN ANTHROPOMETER	91
FIGURE 41:	DETECTO STANDING SCALE	91
FIGURE 42:	TYCOS SPHYGMOMANOMETER AND SETHOSCOPE	91
FIGURE 43:	KOMELON NEO 330 (20 M) TAPE MEASURE AND AVANT SPORT TIMER STOP-WATCH	92
FIGURE 44:	CYBEX BICYCLE ERGOMETER	92
FIGURE 45:	CYBEX NORM 7000	92
FIGURE 46:	BASELINE TM GONIOMETER	93
FIGURE 47:	JOINT EXAMINATION	94

XVIII

FIGURE 48:	BLOOD SAMPLE BEING DRAWN	95
FIGURE 49:	QUESTIONNAIRES COMPLETED BY SUBJECTS	95
FIGURE 50:	HEIGHT MEASUREMENT	96
FIGURE 51:	BODY MASS MEASUREMENT	97
FIGURE 52:	BLOOD PRESSURE MEASUREMENT	97
FIGURE 53:	50-FT WALK	98
FIGURE 54:	GRIP STRENGTH MEASUREMENT	99
FIGURE 55:	AEROBIC CAPACITY	99
FIGURE 56:	MUSCLE STRENGTH TESTING	101
FIGURE 57:	WRIST EXTENSION MEASUREMENT	101
FIGURE 58:	WRIST FLEXION MEASUREMENT	102
FIGURE 59:	KNEE EXTENSION MEASUREMENT	103
FIGURE 60:	KNEE FLEXION MEASUREMENT	103
FIGURE 61:	CYCLING	104
FIGURE 62:	STANDING HIP ABDUCTION	105
FIGURE 63:	STANDING HIP ADDUCTION	105
FIGURE 64:	WALL SQUATS	106
FIGURE 65:	STANDING CALF-RAISES	106
FIGURE 66:	PELVIC TILT ON SWISS BALL	106
FIGURE 67:	CRUNCHES	107
FIGURE 68:	SHOULDER ROLLS BACKWARDS	107
FIGURE 69:	NARROW-GRIP INCLINE PULL-DOWN	107
FIGURE 70:	LATERAL RAISES	108
FIGURE 71:	TREADMILL (WALKING)	108
FIGURE 72:	HEALTH-WALKER	108
FIGURE 73:	CYCLING	109
FIGURE 74:	HAMSTRING STRETCH	109
FIGURE 75:	KNEE-TO-CHEST STRETCH	109

XIX

FIGURE 76:	SHOULDER STRETCH	110
FIGURE 77:	CYCLING WITH GENTLE HAND EXERCISES	110
FIGURE 78:	CYCLING SUPPORTED BY NOODLE	111
FIGURE 79:	STANDING HIP ABDUCTION/ADDUCTION	111
FIGURE 80:	STANDING KNEE EXTENSION/FLEXION	111
FIGURE 81:	STANDING CALF-RAISES	112
FIGURE 82:	STANDING PELVIC TILT	112
FIGURE 83:	REVERSE CRUNCHES	112
FIGURE 84:	ALTERNATIVE SHOULDER EXTENSION/FLEXION	113
FIGURE 85:	SHOULDER ABDUCTION/ADDUCTION	113
FIGURE 86:	CYCLING, SEATED ON NOODLE	113
FIGURE 87:	JOG WITH WRIST AND FINGER EXERCISES	114
FIGURE 88:	HAMSTRING STRETCH AGAINST THE WALL	114
FIGURE 89:	KNEE-TO-CHEST STRETCH	114
FIGURE 90:	SHOULDER STRETCH	115
FIGURE 91:	TOTAL TENDER JOINT COUNT	120
FIGURE 92:	TOTAL SWOLLEN JOINT COUNT	122
FIGURE 93:	ERYTHROCYTE SEDIMENTATION RATE (ESR)	123
FIGURE 94:	HEMOGLOBIN (HB)	125
FIGURE 95:	HEALTH ASSESMENT QUESTIONNAIRE (HAQ)	126
FIGURE 96:	PROFILE OF MOOD STATES (POMS)	129
FIGURE 97:	BODY MASS	130
FIGURE 98:	DIASTOLIC BLOOD PRESSURE	131
FIGURE 99:	SYSTOLIC BLOOD PRESSURE	131
FIGURE 100:	50-FT WALK TEST	132
FIGURE 101:	RIGHT GRIP STRENGTH	133
FIGURE 102:	LEFT GRIP STRENGTH	133
FIGURE 103:	RELATIVE VO ₂ MAX	135

XX

FIGURE 104:	ABSOLUTE VO2MAX	135
FIGURE 105:	RIGHT FLEXOR STRENGTH	138
FIGURE 106:	LEFT FLEXOR STRENGTH	138
FIGURE 107:	RIGHT EXTENSOR STRENGTH	140
FIGURE 108:	LEFT EXTENSOR STRENGTH	140
FIGURE 109:	RIGHT WRIST EXTENSION ROM	143
FIGURE 110:	LEFT WRIST EXTENSION ROM	144
FIGURE 111:	RIGHT WRIST FLEXION ROM	144
FIGURE 112:	LEFT WRIST FLEXION ROM	145
FIGURE 113:	RIGHT KNEE FLEXION ROM	146
FIGURE 114:	LEFT KNEE FLEXION ROM	146



LIST OF TABLES

TABLE		PAGE
TABLE I:	THE AMERICAN RHEUMATISM ASSOCIATION 1987 REVISED CRITERIA FOR THE CLASSIFICATION OF RA	21
TABLE II:	LIMBERING-UP EXERCISES	57
TABLE III:	CRITICAL RANGES OF MOTION THAT SUBSERVE FUNCTION	57
TABLE IV:	MUSCLE & JOINTS TARGETTED FOR STRENGTH TRAINING AND STRETCHING	66
TABLE V:	FACTORS DIMINISHING HAND-GRASP STRENGTH IN RA	76
TABLE VI:	SUBJECT DATA	90
TABLE VII:	EQUIPMENT	90
TABLE VIII:	WATER & LAND EXERCISE PROGRAMME EQUIPMENT	93
TABLE IX:	TOTAL TENDER & SWOLLEN JOINT COUNTS	121
TABLE X:	HAEMATOLOGY	124
TOTAL XI:	TOTAL HAQ AND POMS SCORES	128
TOTAL XII:	PHYSICAL STATUS	136
TABLE XIII:	PHYSICAL STATUS	141
TABLE XIV:	PHYSICAL STATUS	147



XXII

LIST OF APPENDICES

APPENDIX

APPENDIX A:	INDEMNIFICATION FORM	174
APPENDIX B:	FUNCTIONAL IMPAIRMENT (STEINBROCKER, FUNCTIONAL IMPAIRMENT CLASSIFICATION)	175
APPENDIX C:	AMERICAN COLLEGE OF RHEUMATOLOGY, RHEUMATOID ARTHRITIS CLINICAL RESPONSE CRITERIA (JOINT EXAMINATION FOR SOFT-TISSUE SWELLING, TENDERNESS AND PAIN DURING MOTION)	176
APPENDIX D:	HEALTH ASSESSMENT QUESTIONNAIRE (EVALUATION OF THE EFFECT OF TREATMENT ON FUNCTIONAL ABILITY IN RA)	178
APPENDIX E:	PROFILE OF MOOD STATES (IDENTIFIABLE MOOD OR AFFECTIVE STATES)	181
APPENDIX F:	FUNCTIONAL ASSESSMENT FORM	182