

Medical Education Systems, Inc.



Hand Therapy



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Hand Therapy and Rheumatoid Arthritis

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Learning Objectives

Upon successful completion of this course, you will be able to:

- Define what is meant by “hand therapy”
- Identify the Scope of Practice and Domains of Hand Therapy
- Discuss the scientific basis of hand therapy
- Define and explain what is meant by rheumatoid arthritis
- Describe the scientific studies of the impact hand therapy had on patients in this course

Definition of Hand Therapy

Hand therapy is the art and science of rehabilitation of the upper quarter of the human body. Hand therapy is a merging of occupational therapy and physical therapy theory and practice that combines comprehensive knowledge of the upper quarter, body function, and activity. Using specialized skills in assessment and treatment, hand therapists promote the goals of prevention of dysfunction, restoration of function and/or reversal of the progression of pathology in order to enhance participation in life situations for individuals with upper quarter disease or injury.

Who Are Hand Therapists?

Hand therapists are certified or licensed occupational therapists or physical therapists, who through advanced continuing education, clinical experience and independent study have become proficient in the treatment of pathological upper-quarter conditions resulting from trauma, disease, or congenital or acquired deformity. A Certified Hand Therapist (CHT) is an occupational therapist or physical therapist who has met the standards established by the Hand Therapy Certification Commission, Inc.

Scope of Practice and Domains of Hand Therapy

The Scope of Practice of Hand Therapy may include one or more of the domains described below. Domains describe major areas of responsibility in hand therapy. The first three domains include assessment and treatment of hand patients. In compliance with state and federal law, treatment is based on the results of assessment and may be provided on a one-to-one basis, in a group, or by consultation. The fourth domain describes services to specific population groups. The final two domains describe activities associated with professional practice. The domains and their associated tasks are listed below:

Evaluate upper quarter & relevant patient characteristics

Obtain and review medical, psychosocial, and vocational history; Interview patient; Plan for and select assessment tools; Assess and document skeletal, muscular, nervous, vascular, skin and connective tissue status, functional and/or ergonomic status and psychosocial factors; Reassess and document patient status at appropriate intervals.

Develop treatment and discharge plans

Integrate theoretical knowledge bases and patient goals into treatment; Establish short-term and long-term goals of treatment; Establish frequency of treatment in collaboration with patient and referring physician; Determine rehabilitation potential; Select appropriate treatment techniques; Identify appropriate resources to which patients can be referred; Consult with and refer to other health care professionals; Document the

treatment plan; Assess readiness and determine discharge needs including return to work; Formulate and document discharge plan.

Implement treatment plans

Implement and modify treatment/interventions to address edema/vascularity, pain, scar, range of motion /flexibility, wounds, strength, dexterity, sensation, function, endurance and posture/movement.

Provide population-based service

Determine needs of the target population (e.g., industrial, athletic, and performing artistic groups); Make intervention recommendations (e.g., education programs, prevention strategies, ergonomic modifications and screening) based on available resources; Assist in implementation of interventions; Monitor effectiveness of interventions; Serve as a resource person/consultant.

Organize and manage service

Comply with regulations that ensure environmental safety; Advocate for patients; Ensure compliance with organizational policies and procedures; Participate in case management; Assess patient satisfaction.

Promote professional practice

Maintain ethical and legal standards; Participate in evidence-based (i.e., scientifically-based, outcome-based) practice; Interpret and apply clinical research and outcome studies.

SCIENTIFIC KNOWLEDGE BASIS OF HAND THERAPY

The foundation of hand therapy is comprehensive understanding of:

- Surface anatomy
- Anatomy and physiology of the skin/connective, muscular, skeletal, nervous, and vascular/lymphatic systems
- Physical properties (e.g., heat, water, light, electricity, and sound)
- Wound healing
- Behavioral science, and psychological reactions to impairment
- Research design and statistics
- Kinesiology and biomechanics
- Posture and pathomechanics
- Etiology and pathology of medical conditions
- Surgical and medical treatment of conditions
- Standardized and non-standardized assessment tools
- Treatment rationale, indications and contraindications
- Treatment methods, techniques, and tools
- Expected functional outcomes of treatment
- Expected physiological and psychological effects of treatment procedures
- Regulatory and legal guidelines
- Resource management

- Professional codes of ethics
- Safe and appropriate use and maintenance of equipment and assistive devices
- Safety techniques and procedures (e.g., infection control, emergency procedures, practitioner safety, environment)

HAND AND UPPER QUARTER PATIENTS

Theoretical knowledge and technical skills are applied, using good clinical judgment, in assessment and treatment of individuals with diagnoses related to the upper quarter (hand, wrist, elbow, shoulder girdle, cervical area or multiple joints). These may include but are not limited to:

- Amputations
- Central nervous system disorders as they relate to the upper quarter
- Congenital differences/anomalies
- Cumulative trauma disorders/repetitive stress injuries
- Dupuytren's contracture
- Flexor/extensor tendon injuries
- Fractures/dislocations/joint instabilities
- Infections
- Inflammatory and degenerative arthritis
- Multiple system trauma
- Nail bed injuries
- Pain-related syndromes
- Peripheral nerve compression and disease
- Peripheral nerve injuries
- Post-mastectomy/post-radiation lymphedema
- Psychogenic disorders involving the upper quarter
- Soft tissue injuries
- Thermal injuries
- Tumors and cysts
- Vascular disorders

Such patients may be referred to a hand therapist following a variety of medical or surgical interventions including:

- Amputation revision
- Arthroplasty
- Arthrodesis
- Fasciectomy/fasciotomy
- Fracture fixation/bone graft
- Ganglionectomy
- Injections
- Joint reconstruction
- Joint releases
- Joint synovectomy
- Ligament repair

- Nail bed repair
- Nerve blocks/sympathectomies
- Nerve decompressions
- Nerve grafts/nerve repairs
- Neurolysis
- Replantation/re-vascularization
- Scar revisions
- Skin grafts/flaps
- Soft tissue releases
- Tendon grafts/tendon repairs
- Tendon transfer
- Tenolysis
- Tenosynovectomy
- Tissue transfers
- Use of pharmaceutical agents

TREATMENT TECHNIQUES AND TOOLS

A variety of techniques and tools may be used in therapeutic intervention with hand and upper quarter patients, including but not limited to:

- Activity
- Adaptive/assistive devices
- Training in activities of daily living (ADLs)
- Behavior management
- Compressive therapy
- Desensitization
- Electrical modalities
- Ergonomic modification
- Exercise
- Manual therapy
- Patient and family education
- Prosthetics
- Sensory re-education
- Splinting
- Standardized and non-standardized assessment tools
- Strengthening
- Thermal modalities
- Work hardening/retraining
- Wound care/dressings/topical agents

ASHT Established Excellence in Hand Therapy

The American Society of Hand Therapists was incorporated in 1977 to advance the specialty of hand therapy through communication, education, research and the establishment of clinical standards.

At that time, membership in ASHT was restricted to therapists practicing in the United States or Canada. In addition to clinical hours, therapists had to submit a patient log, case studies and complete an extensive application. Membership in ASHT became a de facto form of certification, because of the stringent application process required. Members of ASHT were recognized in the field as being experts.

Governmental Influences in the 1970's

In the mid-1980's, antitrust laws against organizations with strict membership qualifications were being enforced. It was felt that restricting membership was a form of discrimination and that membership in an organization should be open to a broad range of individuals in a professional field. Since the late 1970's, the federal government had already been encouraging the formation of voluntary certification programs that would not be federally regulated. These two trends led ASHT to establish a certification committee in 1984 to study other organizations and present options to the members. The committee discovered that the National Organization for Competency Assurance (NOCA) in Washington, D.C. had established guidelines for organizations that offer professional certification. Those guidelines were used to form the framework for hand therapy certification.

First Practice Analysis in 1985

The first step in the process was a role delineation study (now commonly known as a practice analysis) of hand therapy. A survey was written with consultation from a professional testing company. The survey was sent to ASHT members and non-members who practiced hand rehabilitation. The results of the survey formed the basis of the Scope of Practice and were used to write the original test blueprint. The results of the survey were published in the *Journal of Hand Therapy* in 1987. Based on the report of the certification committee, the members of ASHT voted to proceed with hand therapy certification at the 1987 Annual Meeting.

HTCC Incorporates in 1989

ASHT helped to incorporate HTCC as a separate entity in 1989, prior to administration of the first Hand Therapy Certification Examination in 1991. Since then, ASHT and HTCC have maintained a close relationship to promote the missions of both organizations. However, they are administratively independent and they do not have influence over the policies, procedures or activities of the other organization.

Occupational Therapy: Hand Function Assessment

- **Evaluating the Components of Hand Function**

1. Ability to Perform Prehension Patterns

- A. Grasp

1. Bilateral Palmar - holding a 12" playball
 2. Cylindrical - a primitive hold, holding a soup can
 3. Spherical - power grip, holding a baseball
 4. Finger Hook - thumb not required, holding a 1" dowel

- B. Pinch

1. Tip - requires good coordination, holding a marble
 2. Palmar - used in 60% of ADL's, holding a pencil
 3. Lateral - strongest, turning a key

2. Ability to Release Above Objects

3. Ability to Oppose Digits

Grading

unable
incomplete
completes with maximal difficulty
completes with moderate difficulty
completes with minimal difficulty
normal

- **Evaluating the Performance of the Hand Function Components**

1. Prehension Components

- A. Reach
 - B. Grasp
 - C. Hold
 - D. Carry
 - E. Placement
 - F. Release

2. Movements Combinations Required for Normal Hand Function

A. Arm

1. Elevation through flexion
2. Elevation through abduction
3. Elbow flexion and extension in varying degrees of supination/pronation

B. Hand

1. Radial deviation with wrist extension
2. Wrist extension while hand grips object
3. Opposition of digits
4. Extension of digits with flexion of DIP's and PIP's
5. Supination with object in hand

3. Performance Factors

- A. Range of reach, range of transport
- B. Strength and endurance
- C. Precision and coordination
- D. Speed

Rheumatoid Arthritis Occupational Therapy Treatment Process

- **Problems**

ADL impairment (selfcare, daily life management, leisure)
Mobility impairment
Limited activity tolerance and endurance
Restricted range of motion
Limited strength
Joint deformity and instability
Joint pain, swelling and stiffness
Impaired hand function, manipulation and dexterity
Depression with poor self concept

- **Occupational Therapy Interventions**

ADL and IADL training

Train in alternative methods and/or adaptive equipment:

- Improves grasp (built-ups)
- Compensate for range of motion loss (dress stick)

- Improves ease of performance (electric can opener)
- Prevent stress on joints (lever door handle)
- Prevent prolonged grasp (book holder, Dycem)
- Compensate for weak/absent muscle (u-cuff, jar opener)
- Prevent accidents (bathseat, nonskid rugs)

Provide safety training and environmental modifications

Educate in energy conservation, work simplification and activity balancing

Instruct in joint protection, body mechanics and posture.

- Positioning devices for bed and chair
- Promote functional positioning of joints at risk
- Provide splints to support inflamed and/or weakened joints

Increase active and passive range of motion

- Provide structured ROM exercise program
- Use paraffin to increase ROM
- Perform ROM exercises even when joints are inflamed, to maintain joint motion

Increase strength

- Provide structured, gently resistive, isometric exercise program
- Short duration within limits of pain and fatigue
- Balanced with rest to the joints involved

Decrease pain

- Educate about pain cycle
- Encourage follow-through of exercise program, relaxation techniques and joint protection techniques
- Heat and cold modalities
- Coordinate medication peak with exercise and activity
- Relaxation techniques

- **Precautions**

Muscle test in midrange, isometrically and only when patient is pain free and without inflammation. When joints are inflamed or active, do not perform resistive exercises

Rheumatoid Arthritis of the Hand

What is arthritis?

Arthritis literally means “inflamed joint.” Normally a joint consists of two smooth, cartilage-covered bone surfaces that fit together as a matched set and that move smoothly against one other. Arthritis results when these smooth surfaces become irregular and don’t fit together well anymore and essentially “wear out.” Arthritis can affect any joint in the body, but it is most noticeable when it affects the hands and fingers. Each hand has 19 bones, plus 8 small bones and the two forearm bones that form the wrist. Arthritis of the hand can be both painful and disabling. The most common forms of arthritis in the hand are osteoarthritis, post-traumatic arthritis (after an injury), and rheumatoid arthritis. Other causes of arthritis of the hand are infection, gout, and psoriasis.

Rheumatoid arthritis of the hand

Rheumatoid arthritis affects the cells that line and normally lubricate the joints (synovial tissue). This is a systemic condition (can affect the whole body), which means that it may affect multiple joints, usually on both sides of the body. The joint lining (synovium) becomes inflamed and swollen and erodes the cartilage and bone. The swollen tissue may also stretch the surrounding ligaments, which are the connective tissues that hold the bones together, resulting in deformity and instability. The inflammation may also spread to the tendons, which are the rope-like structures that link muscles to bones. This can result in stretching out of and ruptures of the tendons. Rheumatoid arthritis of the hand is most common in the wrist and the finger knuckles (the MP and PIP joints (see Figure 1).

Signs and symptoms of rheumatoid arthritis of the hand

Stiffness, swelling, and pain are symptoms common to all forms of arthritis in the hand. In rheumatoid arthritis, some joints may be more swollen than others. There is often a sausage-shaped (fusiform) swelling of the finger. Other symptoms of rheumatoid arthritis of the hand include:

- a soft lump over the back of the hand that moves with the tendons that straighten the fingers
- a creaking sound (crepitus) during movement
- a shift in the position of the fingers as they drift away from the direction of the thumb (see Figure 2)
- swelling and inflammation of the tendons that bend the fingers, resulting in clicking or triggering of the finger as it bends, and sometimes causing numbness and tingling in the fingers (carpal tunnel syndrome)
- rupture of tendons with loss of ability to straighten or bend certain fingers or the thumb
- unstable joints in the wrist, fingers, and thumb
- deformity in which the middle joint of the finger becomes bent and the end joint

hyperextended (Boutonnière deformity (see Figure 3)

- hyperextension (sway-back) at the middle joint of the finger associated with a bent fingertip (swan-neck deformity (see Figure 3)

How arthritis of the hand is diagnosed

Your doctor will examine you and determine whether you have similar symptoms in other joints and assess the impact of the arthritis on your life and activities. The clinical appearance of the hands and fingers helps to diagnose the type of arthritis. X-rays will also show certain characteristics of rheumatoid arthritis, such as narrowing of the joint space, swelling and diminished bone density near the joints, and erosions of the bone. If your doctor suspects rheumatoid arthritis, he or she may request blood or other lab tests to confirm the diagnosis.

Treatment of rheumatoid arthritis

Treatment is designed to relieve pain and restore function. If you have rheumatoid arthritis in your hands, medications can help decrease inflammation, relieve pain and slow the progression of the disease. Anti-inflammatory medications, oral steroids, and/or cortisone injections may be used. Several disease-modifying treatments are now available, including anti-malarial drugs, methotrexate, cyclosporine, gold, and other new drugs (remicade, enbrel) that help suppress the body's immune system to reduce the inflammation and pain. A rheumatologist will often prescribe and monitor these types of medications. Your physician may also refer you to a hand therapist for exercises, splints, modalities such as paraffin (warm wax) baths, and instruction on how to use your hands in ways that may help relieve pain and pressure and also protect your joints. Adaptive devices may help you cope with the activities of daily living.

Rheumatoid arthritis often affects the tendons as well as the joints. The tendons that become inflamed may trigger (click) or rupture. If this happens, you may be unable to bend or straighten your fingers or to grip properly. In certain cases, specific preventive surgery may be recommended. Preventive surgery may include removing nodules, releasing pressure on tendons by removing the inflamed tissue and degenerated, rough bone that may scrape the tendons, and reinforcing the tendons. If a tendon rupture has occurred, a hand surgeon may be able to repair it with a tendon transfer or graft, in addition to performing these other procedures.

Surgery to treat the arthritic joints includes removal of inflamed joint linings, joint replacements, joint fusions, and in some cases, removal of damaged bone. The specific procedure(s) depends on a variety of factors, including the particular joint(s) involved, the degree of damage present, the condition of adjacent joints, and your own needs. Your hand surgeon can help you decide on the most appropriate treatment for you.

Unfortunately, there is no cure for rheumatoid arthritis. However, surgical procedures can often help correct deformities, relieve pain, and improve function. Optimal care entails a team approach between the rheumatologist, hand surgeon, hand therapist, and patient. It

is particularly important that surgical intervention be appropriately timed to rebalance the hand and preserve the joints for as long as possible, before the development of more severe deformities has occurred.

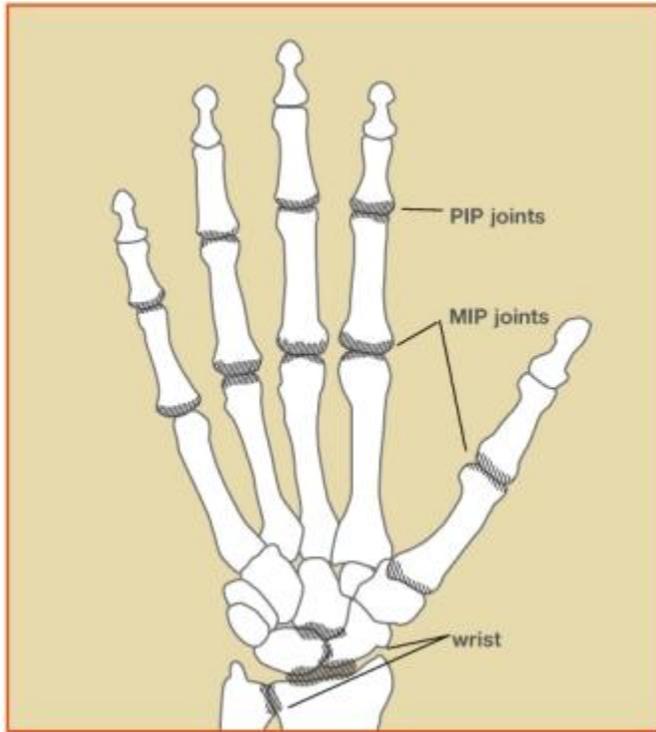


Figure 1: Joints affected by rheumatoid arthritis



Figure 2: Drift of the fingers away from the thumb

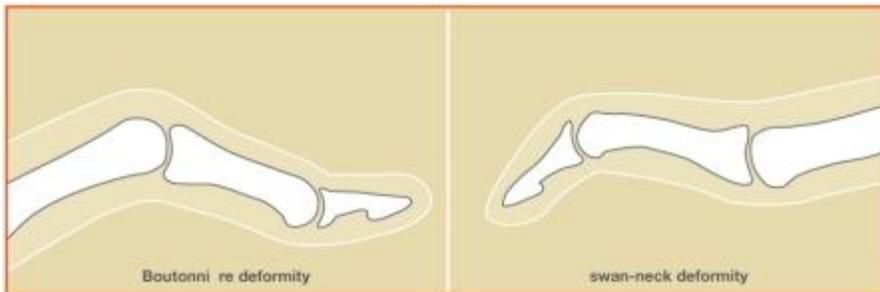


Figure 3: Boutonniere and swan-neck finger deformities

Motor performance of the hand in patients with rheumatoid arthritis

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Abstract

OBJECTIVES—To examine the motor performance of the hand in a sample of patients with rheumatoid arthritis (RA).

SUBJECTS—The patient group comprised 21 (two men, 19 women) patients with RA. Twenty one control subjects matched for age and sex were selected from a larger reference group, which had been drawn from the local population.

METHODS—The measured motor performance aspects were simple reaction time, choice reaction time, speed of movement, finger tapping speed, and coordination (that is, speed of movement/accuracy). Results were compared for age and sex matched pairs. The measurements were made with the Human Performance Measurement/Basic Elements of Performance system, which is a multifunctional system designed to measure different motor aspects of the hands, including reaction time, movement speed, tapping speed, and coordination.

RESULTS—A comparison of the results for the patient and control groups indicated that the motor functions of patients with RA were impaired in all the measured aspects (with the exception of the index finger tapping test). The difference between the groups varied between 11% and 21% for the reaction time tasks, between 12% and 18% for the speed of movement tasks, and between 15% and 17% for the coordination task.

CONCLUSION—Based on the results of our research, it seems that RA decreases some motor performance functions of the hand expressed as simple reaction time, choice reaction time, speed of movement, and coordination. The changes were emphasized in movements performed with several joints.

(*Ann Rheum Dis* 2000;59:812-816)

Introduction

Rheumatoid arthritis (RA) causes reduced functional capacity,¹ which leads to difficulties in activities of daily living. Inflammatory and destructive changes of the joints may cause pain and decrease the range of motion in joints, and inflict periods of immobilization, resulting in muscular atrophy.² Many previous investigators have studied the muscle strength of patients with RA, and the impaired muscle strength and functions of patients with RA compared with those of healthy controls have been known for several years.³⁻⁵ However, the authors of the previous studies have given little attention to the effects of RA on other components of the performance of the hands, such as coordination and motor performance.

In one of the rare motor performance studies dealing with patients with RA, Ginsburg *et al* studied cognitive functions (including switching attention and hand-eye coordination

tasks) in patients with systemic lupus erythematosus (SLE) or RA and noticed that the patients with SLE had poorer performance in tests measuring attention and visuospatial ability than patients with RA.⁶ However, they did not have healthy controls for comparison.

As RA causes functional limitations in the joints, we proposed that this might affect the movements or the movement patterns of the damaged and inflamed joints and designed a study to investigate these possible movement changes in five different tasks.

The purpose of the study was to examine the motor performance of the hand in a sample of patients with RA. The measured motor performance aspects were simple reaction time, choice reaction time, speed of movement, finger tapping speed, and coordination (that is, speed of movement/accuracy).

Subjects and methods

SUBJECTS

Patient group

The patient group comprised 21 patients with RA (two men, 19 women) admitted to hospital⁷ for orthopedic surgery (11 for the hands and six for the feet) or for conservative treatment of their RA (four patients). At the time of the study, 18/21 (86%) patients used some disease modifying antirheumatic drug (DMARD), five of them received a combination of drugs. The patients had no neurological symptoms. Table [1](#) gives detailed demographic and clinical data of the patients with RA. All patients were classed as right handed as this was their preferred hand for writing.

Table 1 Demographic and clinical data of the patients with rheumatoid arthritis

<i>Variable</i>	<i>Mean</i>	<i>SD</i>	<i>Range</i>	<i>Median</i>	<i>95% CI for median</i>
Age (years)	53.1	12.0	33-75	54	44 to 62
Weight (kg)	60.3	8.5	48-75	62	53 to 65
Height (cm)	161.6	5.4	152-172	162	158 to 165
Disease duration (years)	16.8	11.4	1-33	18	5 to 27
No of DMARDs* to date	4.6	2.1	0-10	4	4 to 5
Inflamed joints (n)	8.9	6	1-26	8	5 to 14
Tender joints (n)	9.3	7.0	1-28	8	4 to 15
Tender joints (hand) (n)	4.7	4.2	0-17	4	1 to 7
Swollen joints (hand) (n)	5.9	4.6	0-21	5	3 to 8
ESR*	39.9	24.3	14-110	31	25 to 48
CRP*	30.5	21.9	5-70	23	13 to 54
Pain VAS* (mm)	35	26	0-80	40	10 to 53
Grip strength (kPa)	26.7	26.6	0-115	18	10 to 40
KFT* hand (score)	21.6	14.1	0-40	26	8 to 35
KFT shoulder (score)	3.7	3.6	0-10	3	0 to 7
KFT total (arm) (score)	25.3	16.7	0-48	30	9 to 41

* DMARDs = disease modifying antirheumatic drugs; ESR = erythrocyte sedimentation rate; CRP = C reactive protein; VAS = visual analogue scale; KFT = Keitel function test.

Control group

The control group matched for age and sex was selected from a larger reference group, which had been drawn earlier (1992) from a local population.⁸ In the earlier reference group study, the aim was to recruit 200 healthy subjects. To achieve this target, 500 subjects (50 in each age decade and sex group) were randomly selected (an age- and sex-specified sample was ordered from the Finnish Census Bureau in February 1992) from among the population of Oulu (population on 1 January 1992 was 102 280 inhabitants). Then 343 letters were sent in the order of the names on the list to recruit 200 healthy volunteers of the required age and sex (response rate 58%). The main criterion for inclusion was normal motor function and an ability to perform the tests. The subjects had different socioeconomic and educational backgrounds, and preferred handedness was self reported by the subjects. The sample comprised 100 women and 100 men, categorized by sex and age decade into 10 groups (for example, 21-30 year old men). Each group comprised 20 subjects.

Twenty one control subjects matched for age (mean (SD) 53.1 (12.1) years, range 33-75) and sex (two men, 19 women) were selected from the reference study sample. A suitable control subject was found for each patient with RA when the age range ± 1 year was used. When two or more aged matched controls were available (four cases), the control subject was drawn at random. The mean (SD) height of the control group was 162.3 (9.3) cm, range 150-192, and the mean (SD) weight was 64.7 (12.0) kg, range 53-105. All patients were classed as right handed as this was their preferred hand for writing.

TEST PROCEDURE

The study was based on a cross sectional design, in which the patients with RA and controls were measured once. The same person measured all subjects, and standardized instructions and explanations of the testing procedure were given to the subjects. Pairs matched for age and sex were set up, and the results for the patient and control groups were compared.

Clinical examination of the patients with RA included measurements of the number of tender and swollen joints, and pain (visual analogue scale (VAS)).⁹ In addition, grip strength of the dominant hand (Martin vigometer) was measured. The Keitel function test (KFT),¹⁰ a well known measure of impairment in RA, was used to assess various functional patterns of the arms and legs. The original KFT involves a series of 24 range of motion tasks performed by the patient, and it was used here with minor modifications,¹¹ but only the arm tests were included for the present series. The total arm KFT (0-52) was divided into two subgroups of joints, one representing the hands and wrists (0-42) and the other the shoulders (0-10). The laboratory tests included measurements of erythrocyte sedimentation rate and C reactive protein.

The subjects signed an informed consent form agreeing to participate voluntarily in the study, and the study design was accepted by the Oulu University ethics committee.

The Human Performance Measurement/Basic Elements of Performance (HPM/BEP) system (Human Performance Measurement, Arlington, TX 76004-1996) was used for the

collection of motor performance data. In this study the module for the hands (BEP 1) was used. The module for hands (BEP 1) (fig 1) is a multifunctional system designed to measure different motor aspects of the hands, including reaction time, movement speed, tapping speed, and coordination. BEP 1 consists of eight red lights for visual stimuli and 15 touch-sensitive plates that are divided into four regions on top of the module. Different tests are performed on the four regions of the module, and all the tests are performed in a sitting position.

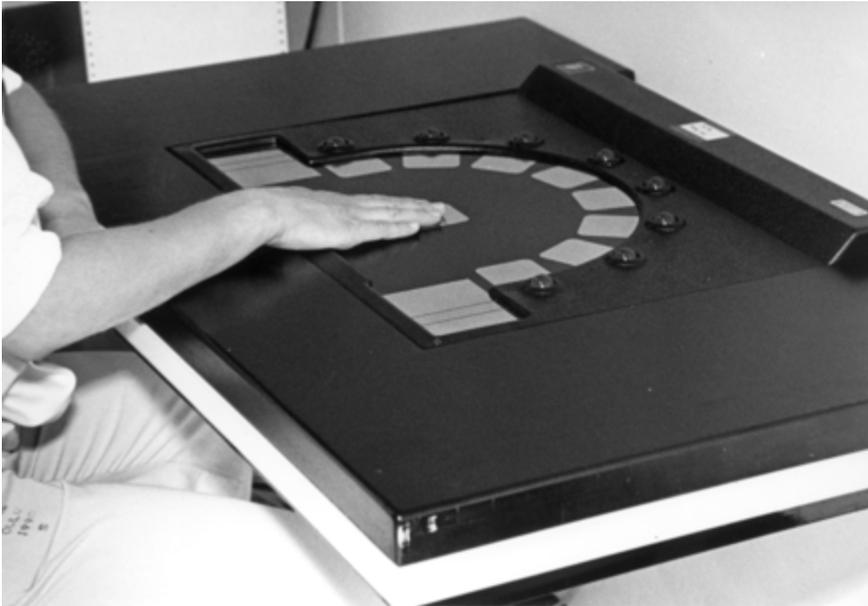


Figure 1 Human Performance Measurement/Basic Elements of Performance device and the measurement of reaction time of the hand.

The same person measured all the subjects and controls, and standardized instructions and explanations of the testing procedures were given to the subjects. All procedures were as described in the manual.¹² The tests were demonstrated, and each subject was allowed to perform some training trials of each test before the measured trials. The trials with anticipation errors or obvious delays were considered to have failed and were repeated. The subjects performed the tests in the same order, and the number of trials and the measurement times were set by the Human Performance Measurement software (HPM/BEP, version 4.2).

The test-retest reliability of HPM/BEP 1 tests has been described in detail by Kauranen and Vanharanta,⁸ and is acceptable. The participants in the reliability study (40 women) were healthy staff members aged 23-53, mean (SD) 33.8 (6.6), at the Oulu University Central Hospital. All the subjects were measured twice on consecutive days, and they performed the same tests on both days. All the subjects were tested for their right side. In the reliability study, the standard error of measurement (SEM) and the intraclass correlation coefficient of reliability (ICC)¹³ values were two choice reaction time: SEM

17.4, ICC 0.75, speed of movement: SEM 8.8, ICC 0.91, tapping speed: SEM 0.2, ICC 0.91, and coordination: SEM 0.5, ICC 0.81.

The test subjects performed the following tests during one measurement session:

- Simple reaction time (five trials)
- One choice reaction time + speed of movement (five trials)
- Two choice reaction time + speed of movement (six trials)
- Index finger tapping speed (two trials)
- Coordination test (two trials).

Simple reaction time test

The test subject was instructed to place her/his hand on the plate, which was situated in the middle of the BEP 1. The test subject then heard a beep signal, which was the sign to be ready for response. Two to six seconds after the acoustic sign all the eight lights were activated simultaneously and the test subject lifted her/his hand as quickly as possible from the plate with a dorsiflexion movement of the wrist joint. Reaction time was expressed in milliseconds, as the time from initiating a light stimulus to the time when the subject lifted her/his hand from the plate. The subjects performed five trials.

One choice reaction time and speed of movement test

The subject heard a beep signal, which was the indication for her/him to be ready for response. Two to six seconds after the acoustic signal a light stimulus appeared, and the subject was instructed to lift her/his hand immediately after the predefined light stimulus appeared and to move it as quickly as possible to the plate immediately in front of the activated light. Two different measures were obtained from each trial: (a) one choice reaction time, expressed in milliseconds, is the time between the appearance of a light stimulus and the hand lifting from the center plate; (b) movement speed, expressed in cm/s, is determined as the distance between the center plate and the target plate (distance 10 cm) divided by the time needed for the performance of the movement. The subjects performed five trials.

Two choice reaction time and speed of movement test

The subject performed the test with the same method as in the one choice reaction time and the speed of movement test, but there were two possible activated lights (measurement system presented stimuli in a pseudo-random order). The subjects performed six trials.

Index finger tapping test

The subject tapped the touch plate with the maximum rate of her/his index finger for 10 seconds. The results were expressed as taps/s. The subjects performed two trials.

Coordination test

The coordination test was a modified Fitts' task,¹⁴ where the movement amplitude and target width were constants. The subject was instructed to tap two narrow plates alternately (the width of the plates was 17 mm and the distance between them 40 cm) as

rapidly as possible and to avoid errors for a period of 10 seconds. Two different measures were obtained from each trial: (a) a measure of accuracy expressed as the percentage of correct hits; and (b) a measure of the average movement speed during the task given in units of cm/s. The final measure was obtained by combining speed and accuracy, and the result was expressed as bits/s.¹⁴ The subjects performed two trials.

STATISTICAL METHODS

Mean value, SD, and 95% confidence intervals of the difference of each test were calculated and presented. A non-parametric paired *t* test (Wilcoxon test for matched pairs) was used to determine whether there was a statistically significant difference between the values of the matched pairs. We used non-parametric statistics rather than parametric statistics because the group consisted of 21 subjects. Parametric statistics require a normal distribution and with "only" 21 subjects this requirement was not fulfilled every time. The correlation between the motor performance tests and the VAS score, the KFT score, grip strength, disease duration, and the number of tender and swollen joints was tested with Spearman's correlation coefficient.

For all statistical tests, the 0.05 level of probability was accepted as the criterion for significance. The statistical software used were the SOLO (version 4.0) (BMDP Statistical Software Inc) and the Statistical Package for Social Sciences (SPSS, version 7.0).

Results

No statistically significant differences in the results by age, sex, weight, and height were found between the patients with RA and the controls, and hence the groups were comparable and equal in these respects.

The results indicated that the reaction times were longer in the group of patients with RA than in the control group on both sides. In the speed of movement tests the patients with RA were slower than the controls on both sides. There were no statistically significant differences in the index finger tapping speed between the groups, but the coordination values of the hands were lower in the patients with RA on both sides. Table [2](#) presents detailed results of the motor performance tests.

Table 2 Motor performance results in the patients with rheumatoid arthritis (RA) and control groups (n=21)

<i>Measurement</i>	<i>Side</i>	<i>Unit</i>	<i>Patients with RA (mean (SD))</i>	<i>Controls (mean (SD))</i>	<i>95 % CI for the difference of mean</i>	<i>p Value</i>	<i>Difference between groups (%)</i>
Simple reaction time	Right	(ms)	217 (44)	192 (30)	4 to 45	0.0173	+13
Simple reaction time	Left	(ms)	208 (30)	187 (27)	4 to 39	0.0129	+11
One choice reaction time	Right	(ms)	272 (46)	245 (46)	4 to 50	0.0199	+11
One choice reaction time	Left	(ms)	272 (57)	235 (36)	13 to 62	0.0028	+16
Two choice reaction time	Right	(ms)	350 (77)	312 (43)	8 to 69	0.0276	+12
Two choice reaction time	Left	(ms)	354 (77)	293 (46)	23 to 101	0.0037	+21
Speed of movement (forward)	Right	(cm/s)	83 (24)	96 (27)	-26 to 0	0.0458	-14
Speed of movement (forward)	Left	(cm/s)	78 (21)	95 (31)	-31 to 0	0.0355	-18
Speed of movement (lateral)	Right	(cm/s)	88 (27)	103 (27)	-33 to 1	0.0150	-15
Speed of movement (lateral)	Left	(cm/s)	82 (31)	93 (26)	-27 to 5	0.0263	-12
Tapping speed	Right	(taps/s)	5.01 (0.82)	5.37 (0.98)	-0.95 to 0.19	0.1842	-7
Tapping speed	Left	(taps/s)	4.91 (0.77)	4.90 (0.97)	-0.58 to 0.60	0.8563	0
Coordination	Right	(bits/s)	8.22 (1.49)	9.65 (1.29)	-2.17 to -0.69	0.0024	-15
Coordination	Left	(bits/s)	7.58	9.16	-2.40 to	0.0017	-17

(1.52)	(0.98)	-0.78
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There was no correlation between the motor performance tests and the VAS score, the KFT score, grip strength, disease duration, and the number of swollen joints. However, the speed of movement (lateral direction) correlated with the number of tender joints of the hands (Spearman's correlation coefficient (r_s) = -0.44 , $p=0.048$ for the right hand, and $r_s=-0.50$, $p=0.021$ for the left hand). In addition, speed of movement of the right hand tended to correlate with the total KFT score of the arm ($r_s=-0.41$, $p=0.06$ in the forward direction test and $r_s=-0.36$, $p=0.09$ in the lateral direction test).

Discussion

The purpose of the study was to examine the motor performance of the hand in a sample of patients with RA. The measured motor performance aspects were simple reaction time, choice reaction time, speed of movement, finger tapping speed, and coordination. Comparison of the results for the patients with RA and for the healthy controls matched for age and sex, indicated that the motor functions of patients with RA were impaired in all the measured aspects (except the index finger tapping test). The difference between the groups varied between 11% and 21% in the reaction time tasks, between 12% and 18% in the speed of movement tasks, and between 15% and 17% in the coordination task.

The reason for these differences may be explained by the neuromuscular problems of the patients with RA. Previous studies have shown an association between RA and nerve function impairment,¹⁵ and it seems that RA accelerates muscle fibre degeneration, especially in fast-twitch muscle fibres.¹⁶ There is also a clear difference in the shape of the force-time curve between patients with RA and healthy subjects at all force levels. Healthy subjects produce higher force levels in rapid isometric muscle action.¹⁷ In addition, one reason for the poorer performance of patients with RA may be that the destructive and inflammatory changes in joints and pain or fear of pain prevent the subjects from performing fast movements as quickly as normal.

All the measured motor performance aspects are essential and important for various daily activities, which constitute a substantial part of human life, and their importance is especially great in traffic, sports, and unexpected situations, but we found no previous motor performance studies on patients with RA with which to compare our results.

The results indicated that the reaction times were longer in the RA group than in the control group for both hands. Reaction time is a common method to study a person's central information processing speed and fast coordinated peripheral movement response. Reaction time tasks load and involve both the central and the peripheral components and functions. Our patients were severely impaired (for example, KFT was rather high), and it may be that the abovementioned lower motor unit problems and the destructive and

inflammatory changes (for example, joint stiffness, deformations, and limitations in range of motion) in joints prevent patients with RA from performing fast movements as quickly as normal. In addition, the pain or fear of pain may delay these movements. We performed three reaction time tasks, and it should be noted that the difference between the groups did not increase when the number of possible choices increased (for example, in a two choice reaction time task), but the patients with RA only were slower.

The patients with RA were slower than the controls in the speed of movement tests. This finding might be mainly a consequence of unpleasant feelings of pain or fear of pain during movements (the speed of movement correlated with the number of tender joints of the hand), which leads to avoidance of fast movements. The speed of movement indicates the subject's ability to perform fast movements, which are important in different balance and protection movements and reflexes. Based on the results, this might even mean that patients with RA have an increased risk of falling because of their decreased ability to perform fast movements. This shortcoming together with the longer reaction times might be hazardous for rheumatoid patients, because osteoporosis is common among them,¹⁸ which would increase the relative risk of fractures in these patients after a fall.¹⁹

The coordination values of both hands were lower in the RA patient group. The coordination test (modified Fitts' task) involves a type of visually guided motor response, which is an essential component of a wide variety of skills needed for daily work and recreation.²⁰ In coordination tests the final measure was obtained by combining speed and accuracy. The measure of accuracy was expressed as the percentage of correct hits, and the measure of average movement speed during the task given in units of cm/s. We analyzed our coordination results in more detail and noticed that the mean values of speed of movement, in particular, were lower in the patients with RA. Thus it seems that the decrease in total coordination is caused mainly by a decrease in the speed of movement component. This may be explained by physical impairment caused by RA and pain or fear of pain, as discussed earlier for reaction times and speed of movement.

Results of the finger tapping test were an exception as there were no statistically significant differences between the groups in this task. This was surprising, because the movement is performed with one joint and the performance time is longer (10 s) than in the other motor performance tests, which were performed with a single fast movement. We expected that the differences between the groups would have become obvious, especially in a test of longer duration and with repetition of joint movements (for example, the tapping test). However, no such effect was seen. From these results it seems that the differences between the groups were emphasized in movements and tasks that were performed with several joints, and it might be that the condition of the larger joints, such as the shoulder and the elbow joints, have an important role in the fast movements and the total performance of the hand in patients with RA. In exercise therapy special attention should be paid to the movements of these joints.

There were no correlations between the motor performance tests and the VAS score, the KFT score, grip strength, disease duration, and the number of swollen joints. This finding was partly expected because the age range of our group of rheumatoid patients (33-75

years) was so wide, and age explains a considerable portion of the motor performance values⁸ and upsets other relations (the effect of age was controlled with partial correlation analysis). However, it should be noted that the speed of movement (lateral direction) correlated with the number of tender joints of the hands, and the speed of movement of the right hand tended to correlate with the total KFT score of the arm.

STUDY LIMITATIONS

Although we confirmed the hypothesis based on the abovementioned results and rejected the null hypothesis, the number of subjects in this study was quite small and the results might have been more conclusive if a larger sample of subjects had been used. Secondly, the selection of subjects in this study was not random and they included mainly women, which limits the generalization of the results.

It is also to be noted that our series represented a hospital based population with advanced RA. Consequently, their median level of arm KFT was rather high, indicating clearly impaired function. Overall, our data are preliminary and should be tested in a large RA series including early cases.

The control subjects were from various socioeconomic and educational categories. This helps somewhat to generalize the results, and the composition of the sample can be presumed to represent the normal population of the area. However, the subjects were invited by post for the measurements, and this might have caused some selection. The response rate (58%) was quite low and this impairs somewhat the generalization of the results. The precise reason for the low response rate is not known, but studying or working in other cities, shift work, and lack of time in the younger age groups might be possible explanations.

Conclusion

Based on the results of our research, it seems that RA decreases some motor performance functions of the hand expressed as simple reaction time, choice reaction time, speed of movement, and coordination. The changes were emphasized in movements performed with several joints.

References

1. Beals CA, Lampman RM, Banwell BF, Braunstein EM, Albers JW, Castor CW. Measurement of exercise tolerance in patients with rheumatoid arthritis and osteoarthritis. *J Rheumatol* 1985;12:458-461 [[Medline](#)].
2. Herbison GJ, Ditunno JF, Jaweed MM. Muscle atrophy in rheumatoid arthritis. *J Rheumatol* 1987;14(suppl 15):78-81 [[Medline](#)].
3. Tiselius P. Studies on joint temperature, joint stiffness and muscle weakness in rheumatoid arthritis. *Acta Rheumatologica Scandinavica* 1969;suppl 14:1-106 [[Medline](#)].
4. Ekblom B, Lövgren O, Alderin M, Fridström M, Satterström G. Physical performance

- in patients with rheumatoid arthritis. *Scand J Rheumatol* 1974;3:121-125[[Medline](#)].
5. Häkkinen A, Hannonen P, Häkkinen K. Muscle strength in healthy people and in patients suffering from recent-onset inflammatory arthritis. *Br J Rheumatol* 1995;34:355-360[[Abstract/Free Full Text](#)].
 6. Ginsburg KS, Wright EA, Larson MG, Fossel AH, Albert M, Schur PH, *et al.* A controlled study of the prevalence of cognitive dysfunction in randomly selected patients with systemic lupus erythematosus. *Arthritis Rheum* 1992;35:776-782[[Medline](#)].
 7. Arnett FC, Edworthy SM, Bloch DA, McShane DJ, Fries JF, Cooper NS, *et al.* The American Rheumatism Association 1987 revised criteria for the classification of rheumatoid arthritis. *Arthritis Rheum* 1988;31:315-324[[Medline](#)].
 8. Kauranen K, Vanharanta H. The influence of aging, gender and handedness on the motor performance of upper and lower extremities. *Percept Mot Skills* 1996;82:515-525[[Medline](#)].
 9. Scott J, Huskinson E. Graphic representation of pain. *Pain* 1976;2:175-184[[Medline](#)].
 10. Keitel W, Hoffmann H, Weber G, Krieger U. Ermittlung der prozentualen Funktionsminderung der Gelenke durch einen Bewegungsfunktionsstest in der Rheumatologie. *Deutsche Gesundheitswesen* 1971;26:1901-1903.
 11. Hakala M, Nieminen P. Functional status assessment of physical impairment in a community based population with rheumatoid arthritis: severely incapacitated patients are rare. *J Rheumatol* 1996;23:617-623[[Medline](#)].
 12. Kondraske G. *HPM/BEP manual*. 3rd printing. Arlington: Human Performance Measurement, 1991.
 13. Fleiss JL. *The design and analysis of clinical experiments*. New York: Wiley, 1986;2-12.
 14. Fitts PM. The information capacity of the human motor system in controlling the amplitude of movement. *J Exp Psychol* 1954;47:381-391[[Medline](#)].
 15. Haslock D, Wright V, Harriman D. Neuromuscular disorders in rheumatoid arthritis. *Q J Med* 1970;39:335-358[[Free Full Text](#)].
 16. Danneskiold-Samsoe B, Grimby G. Isokinetic and isometric muscle strength in patients with rheumatoid arthritis. The relationship to clinical parameters and the influence of corticosteroid. *Clin Rheumatol* 1986;5:459-467[[Medline](#)].
 17. Häkkinen A, Sokka T, Kotaniemi A, Paananen M-L, Mälkiä E, Kautiainen H, *et al.* Muscle strength characteristics and central bone mineral density in women with recent onset rheumatoid arthritis compared with healthy controls. *Scand J Rheumatol* 1999;28:1-7.
 18. Hansen M, Florescu A, Stoltenberg M, Podenphant J, Pedersen-Zbinden B, Horslev-Petersen K, *et al.* Bone loss in rheumatoid arthritis. Influence of disease activity, duration of the disease, functional capacity, and corticosteroid treatment. *Scand J Rheumatol* 1996;25:367-376[[Medline](#)].
 19. Hooyman J, Melton L, Nelson A, O'Fallon W, Riggs B. Fractures after rheumatoid arthritis. *Arthritis Rheum* 1984;27:1353-1361[[Medline](#)].

20. Wickens CS. *Engineering psychology and human performance*. Columbus: Merrill, 1984.

One-year outcomes of a randomized controlled trial of an educational–behavioural joint protection programme for people with rheumatoid arthritis

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Abstract

Objective. Joint protection aims to reduce pain and local inflammation, preserve the integrity of joint structures and improve function. There is evidence that it can improve pain and function in the short term, but the long-term effects are uncertain. This study evaluated the effects of joint protection in early rheumatoid arthritis (RA).

Methods. A randomized, controlled, assessor-blinded trial of duration 1 yr was conducted. Two interventions (both 8 h) were compared: standard arthritis education, including 2.5 h of joint protection education based on typical UK practice; and a joint protection arthritis education programme, using educational–behavioural teaching methods. Assessments were made at entry and 6 and 12 months.

Results. Sixty-five people with RA attended the joint protection programme and 62 the standard programme. The groups were matched for age (51 and 49 yr), disease duration (21 and 17.5 months) and use of non-steroidal anti-inflammatory drugs and disease-modifying anti-rheumatic drugs. In comparison with the standard group, the joint protection group significantly improved with respect to adherence to the joint protection programme ($P=0.001$), hand pain ($P=0.02$), general pain ($P=0.05$), early morning stiffness ($P=0.01$), self-reported number of disease flare-ups ($P=0.004$), visits to the doctor for arthritis ($P<0.01$), and the AIMS2 (Arthritis Impact Measurement Scales) activities of daily living scale ($P=0.04$). A trend to improved swollen joint counts was identified ($P=0.07$). Within-group analyses also showed improvements in arthritis self-efficacy and perceived control. Hand deformity scores continued to increase in both groups.

Conclusion. We found significant improvements in adherence, pain, disease status and functional ability amongst those attending the joint protection programme. Benefits

became more apparent with time, suggesting that joint protection can help slow the progression of the effects of RA over and above the effects of drug therapy.

Introduction

Joint protection is widely provided as part of the management of people with rheumatoid arthritis (RA). Altering working methods, energy conservation (balancing rest and activity) and using assistive devices should place less strain on joint structures weakened by the disease process. Theoretically, reducing load and the effort required to do everyday tasks should lead to less pressure on pain receptors, less irritation of the synovium and reduction of localized inflammation. This should help preserve the integrity of joint structures for longer, helping to limit the development of deformities. Therefore, function should be easier and functional status maintained for longer [1–5].

Previous research has demonstrated that using assistive devices reduces pain during task performance in comparison with normal methods [6], and altering working methods significantly reduces difficulties with activities of daily living (ADL) [7]. Both these cross-sectional studies recruited people with established RA (on average 8 yr since diagnosis) and moderate functional problems (Health Assessment Questionnaire median score 1.5), demonstrating that joint protection has beneficial short-term effects on pain and function for those with established disease. Joint protection is taught increasingly to people with early-stage disease as a preventative intervention. However, whether people with RA increase their use of joint protection sufficiently to affect pain, inflammation, the integrity of joint structures and function in the longer term is unknown.

People with RA are generally very positive about receiving such advice. However, typical joint protection education (i.e. with a duration of up to 2.5 h, including information about RA, joint protection, demonstrations and short supervised practice) has been shown to improve knowledge of joint protection methods but not to result in significant behavioural change [8–10]. These studies evaluated joint protection as part of arthritis education programmes using a standard recommended format [11] and the education provided was comparable with typical UK practice [12]. In comparison, studies of programmes using educational–behavioural methods have objectively observed significantly increased use of joint protection in people with early RA (<5 yr since diagnosis) [13, 14]. Nordenskiöld [6] and Lindroth *et al.* [15–17] recruited people with established RA (>8 yr on average), and found that self-reported use of joint protection methods increased. However, of these studies, four taught joint protection as part of a multi-intervention arthritis education programme [13, 15–17], so it is difficult to decide whether improvements in pain and function were attributable to joint protection. Only Nordenskiöld's [6] study of a 13-h joint protection programme has reported improvements in pain and function. However, this was a retrospective study with no control group.

Educational–behavioural programmes are more effective in facilitating behavioural change with respect to joint protection. The aim of this study was to evaluate whether joint protection can reduce pain and local inflammation and maintain the integrity of joint structures and functional ability of people with RA 1 yr after attending an educational–behavioural joint protection programme.

Method

Patients

People diagnosed with RA by rheumatology consultants were recruited from two hospitals. Out-patients were normally referred to the arthritis education programmes organized by the occupational therapy units at both hospitals. Following assessment by an occupational therapist, all patients were given or mailed a letter inviting them to attend an arthritis education programme, and asked if they would be willing to participate in a study comparing two types of programme, of similar content but differing teaching styles, to investigate which approach was the more effective. The invitation included a checklist to find out if the patient met the entry criteria. The patients were given the option of bringing a partner or significant other, and an information sheet about the study was provided. Patients were not informed that the main aim of the study was to investigate the use and outcomes of joint protection or about the differences between the two styles of teaching. Ethics approval was obtained at both hospitals.

Patients were eligible to participate if they were aged 18–65 yr, had been diagnosed with RA within the last 5 yr, were experiencing hand pain on activity, had no other medical condition affecting hand function, and had a history of wrist and/or metacarpophalangeal (MCP) joint pain and inflammation.

Interventions

Participants were allocated randomly to attend either a standard education programme (control group) run by the two rheumatology departments or an educational–behavioural joint protection programme (experimental group). Before the trial started, the content and delivery of the two rheumatology departments' standard programmes were compared and found to be very similar. Several meetings were held with staff to ensure the two standard programmes were standardized as much as possible between the two sites and a short manual was developed to facilitate this. Between six and 10 participants usually attended the standard programmes and, with partners included, group size ranged from six to 12 people.

The standard programme included short talks from nursing, medical, occupational therapy and physiotherapy staff on the following: RA; drug treatments; alternative therapies, diet; exercise, rest and positioning; energy conservation; joint protection; assistive devices; splinting; pain and relaxation; and other methods of controlling pain (e.g. heat and ice). Some demonstration and practice of exercise, joint protection and relaxation was included (15–45 min for each). Meetings allowed time for discussion and

information leaflets were provided. The joint protection component lasted 2.5 h during meetings 3 and 4. This programme was designed to be typical of that provided in the UK [12]. Part 1 included the following: information about RA pathophysiology; principles of joint protection and energy conservation; demonstration of some hand-joint protection methods; and a homework task to identify problem activities and to find solutions using the principles taught. Part 2 included the following: discussion of the homework task and finding solutions to other common household, gardening and work difficulties; repetition of principles; a demonstration of hand-joint protection methods applied to making a cup of tea; and group practice of these with the opportunity to try assistive kitchen devices (for 30–40 min).

The joint protection programme was based on the health belief model [18] and the theories of social learning [19] and self-management [20] and was conducted by an experienced rheumatology occupational therapist. Between three and six participants usually attended and, with partners included, numbers were between four and eight. Participants were provided with an information pack and workbook detailing the principles of joint protection, with photographs of a range of joint protection methods. The programme applied educational, behavioural, motor learning and self-efficacy enhancing strategies to increase adherence to the joint protection programme, as well as a range of educational methods to match different group members' learning styles.

Two-thirds of the programme was spent practicing hand-joint protection methods in small groups with feedback on performance from each other and the group leader. People were shown a range of options for task performance, so that they could select which methods worked best for them. Practice started with blocked repetition of single actions and progressed to sequences of activities requiring multiple joint protection methods. Mental rehearsal of actions was also included. Contracting and goal-setting were used to promote the practice of joint protection at home between meetings. People were encouraged to write goals in their workbook and feedback was given on progress and problems at the beginning of each meeting. Individuals' practical problems were also discussed and group members used problem-solving methods to generate solutions. Information was also provided on the disease process, possible outcomes of RA, and drug therapy. (Further details of the programme are available [14].)

Both education programmes were of 8 h duration over four afternoon or evening sessions of 2 h each.

Trial design

A randomized, controlled trial was conducted. After agreement, participants were allocated randomly to an experimental or control group using sealed envelopes prepared in advance, each containing the allocation for one patient, using a four-block sequence as described by Altman [21]. Block randomization was used to ensure a balanced sequential allocation of participants to the two groups, as at least three participants were needed in each education programme to facilitate group discussion, practical participation and feedback. Participants were then telephoned and offered a range of starting dates for the education programmes (within their group) to enable them to attend at their convenience.

Outcome measures

Primary outcome measures

Hand pain experienced during moderate activity.

Hand pain experienced during moderate activity (e.g. cooking a family meal, gardening or housework) within the last week was measured using a 100 mm visual analogue scale (VAS) with end points of 'no pain' and 'pain as bad as it can be'.

Adherence with joint protection.

This was evaluated using a reliable, valid observational measure, the Joint Protection Behavior Assessment [22]. This evaluates joint protection methods when performing 20 tasks required in making a hot drink and snack meal (e.g. turning a tap, filling a kettle and lifting a saucepan). Light conversation is continued throughout this to avoid conscious attention to hand actions and evaluate habitual movements more readily. The score ranges from 0 to 40 (if all 20 tasks are performed correctly) and the score is converted to a percentage. Assessments were video-recorded to enable detailed analysis of hand movements.

Secondary outcome measures

Indicators of disease activity.

These comprised the EULAR 28 tender and swollen joint count (0–84) [23], the patient's and assessor's global ratings of disease severity (using a five-point Likert scale [23]), and the duration of early morning stiffness (in minutes). In addition, a 100 mm pain VAS for overall pain in the last week and the number of disease flare-ups reported in the last 6 months were recorded.

Functional assessment.

The AIMS2 (Arthritis Impact Measurement Scales) was used to assess ADL (self-care and household activities subscales), upper limb function (hand and arm subscales) and lower limb function (mobility and walking subscales). All AIMS2 scale scores range from 0 to 10, with 0 representing good function [24].

Hand status.

Grip strength was measured using a Jamar dynamometer. The Joint Alignment and Motion scale was used to record range of movement and deformity. This scale records percentage limitations in the range of movement and the degree of deformity at the wrist, MCP and proximal interphalangeal (PIP) joints on a scale from 0 to 4 (bilateral score range 0–88) [25]. Measurements were conducted using a goniometer, following standard protocols. The presence of deformities was also recorded (wrist radial deviation of more than 10°=1; wrist palmar subluxation=1; second to fifth MCPs with ulnar deviation of more than 15°=1; second to fifth MCPs with palmar subluxation=1; second to fifth IPs with early deformity (boutonniere/swan-neck)=1; second to fifth IPs with fixed deformity=2; thumb Z deformity=1, bilateral score range 0–38).

Psychological status.

This was measured with the Self-efficacy Pain and Other Symptoms subscales (score range 10–100; higher scores indicate better self-efficacy) [26] and the Rheumatoid Attitudes Index (Helplessness subscale, score range 0–30; Internality subscale, score range 0–36; higher scores indicate worse learned helplessness and poorer sense of internal control) [27].

Other data

Demographic data were collected at baseline (gender, age, disease duration, education and marital status) and a record of drugs prescribed and drug changes in the previous 6 months were obtained at each assessment. (Radiographic analysis was not included because of short trial duration.)

An independent assessor conducted assessments in the participants' own homes at baseline and 6 and 12 months. A questionnaire including the AIMS2, Self-efficacy Scales and Rheumatoid Attitudes Index was mailed 1 week before and collected at each assessment. The assessor was provided with a schedule of completion deadlines for participants' assessments but not informed of group allocation or timing. The assessor was asked to avoid discussing the education programmes with the participants, in order to maintain blinding. Discussion about participants with treatment staff was also avoided.

Statistics

Sample size was analyzed using hand pain VAS data from a previous study [9]. A minimum of 63 participants in each group was needed to detect a 20% difference in hand pain scores (based on a mean hand pain VAS score of 46.90 (S.D. 18.65), power of 0.8 and a significance level of 0.05).

Comparisons between groups to identify differences in outcomes were conducted at 0, 6 and 12 months using the unpaired *t*-test for interval data, the Mann–Whitney *U*-test for ordinal data and the χ^2 test for categorical data. Comparisons within groups were also conducted to establish if changes over time occurred between 0 and 6 months and between 0 and 12 months using the paired *t*-test for interval data and the Wilcoxon matched pairs signed ranks test for ordinal data.

Results

Recruitment occurred over a 2-yr period, during which 403 people were referred to attend an education programme at the two hospitals. Of these, 165 (41%) did not meet the trial entry criteria but were still offered the opportunity to attend a standard programme, and 86 (52%) chose to do so. Of the 238 meeting the entry criteria, 58 (24%) did not wish to attend education and a further 41 (17%) attended but did not wish to participate in the study. Twelve (4%) dropped out after randomization (but before assessment) and were unable to participate due to ill health (five in the standard group and seven in the joint protection group), resulting in 127 (55%) subjects: 62 in the standard group and 65 in the joint protection group.

The two groups were well matched in terms of demographic and baseline variables (Table 1*). A similar percentage in both groups was taking non-steroidal anti-inflammatory drugs (NSAIDs), disease-modifying anti-rheumatic drugs (DMARDs) and/or steroids. In the standard group, 29 (47%) were taking sulphasalazine and 20 (32%) methotrexate. In the joint protection group the corresponding numbers were 28 (43%) and 20 (31%). Some patients were on combination therapy. There were no significant differences in drugs taken or drug changes between the two groups at 6 and 12 months (three in the standard group and nine in the joint protection group stopped DMARDs at 12 months). There was no significant difference in the number of education sessions attended between the two groups [joint protection group, 3.55 (S.D. 0.95) sessions; standard group, 3.31 (S.D. 1.08) sessions; $P=0.17$]. Some data were missing at follow-up because of participants' ill health (four in the standard group and two in the joint protection group at 6 months; two in the standard group and two in the joint protection group at 12 months).

The primary and secondary outcome variables are compared in Table 2*. Use of joint protection increased significantly in the joint protection group. Not all participants agreed to be video-recorded. In the joint protection group, 60% (34/57) increased scores (by more than 10%), 40% (22 participants) doing so by 20% or more. In the standard group, 22% (11/50) increased scores (by more than 10%), but only 10% (five participants) did so by more than 20%. There were no differences between the two groups on any of the other measures at 6 months. Generally, scores in the standard group remained similar at 6 months, but there was a trend to improvement across a number of measures in the joint protection group. Within-group analyses showed that tender and swollen 28-joint counts, grip strength, Hand Joint Alignment and Motion and Assessor Global Disease Status scores improved significantly.

By 12 months, the pattern was for the standard group to have similar scores to baseline or have worsened on some measures (pain, early morning stiffness and assessor's global disease status). The joint protection group had significantly better hand and general pain, patient's and assessor's global disease status scores, AIMS2 ADL scores and less early morning stiffness. The joint protection group also reported significantly fewer disease flare-ups in the last 6 months [joint protection group, 1.05 (S.D. 1.76); standard group, 2.38 (S.D. 3.15); $P=0.004$]. Within-group analyses showed that, at 12 months, the joint protection group had significantly improved in grip strength, Hand Joint Alignment and Motion, assessor's global disease status, Arthritis Self-efficacy for Pain and Other Symptoms and Rheumatoid Attitudes Index (Internality) scores, and had also improved perceptions of Current Health Status and Satisfaction with Health (AIMS2).

Further within-group analyses of the Hand Joint Alignment and Motion scores showed that significant improvements occurred in range of joint movement in the joint protection group: on average, the improvement was 7° at the wrist (from 102 to 109°) and 5° at the MCP (from 77 to 82°) and PIP joints (from 94 to 99°) ($P<0.05$). However, analysis of the deformity scores showed that these significantly increased in both groups from 4.14 (S.D. 4.56) in the standard group at baseline to 5.98 (S.D. 6.21) at 12 months ($P<0.01$) and from 2.40 (S.D. 3.32) in the joint protection group at baseline to 5.16 (S.D. 5.65) at 12

months ($P<0.01$). There was no difference between the two groups in numbers of deformities at 12 months ($P=0.45$).

Participants continued to receive the usual care provided by the rheumatology departments during the trial. At 12 months, the joint protection group had visited a doctor for their arthritis on average 1.14 (S.D. 1.62) times in the previous 6 months, in comparison with 1.98 visits (S.D. 2.02) in the standard group ($P<0.01$). During the study, 22 participants in the standard group and nine in the joint protection group participated in physiotherapy ($\chi^2=7.84$; $P=0.005$), and 13 in the standard and 11 in the joint protection group participated in occupational therapy ($P>0.1$). Two patients in the standard group and one in the joint protection group had hand operations (two extensor tendon repairs and a carpal tunnel release respectively).

Discussion

This study has demonstrated that joint protection is effective once people with RA are enabled to use it sufficiently. Most participants were diagnosed recently (i.e. within 2 yr) and over half were rated as having mild disease at the start of the trial, with relatively few physical and functional problems. As RA is a progressive disease and joint protection aims to be preventative, benefits became more apparent with time. The findings indicate that joint protection does help slow progression of the effects of RA over a period of 1 yr.

The general trend was for the joint protection group's scores to be improved or maintained, whilst the standard group's scores were maintained or slowly worsened. In the joint protection group, increased use of joint protection led to improvements in hand pain and the maintenance of general levels of pain compared with worsening pain in the standard group. Differences were probably greater in hand pain because the joint protection programme focused primarily on hand joint protection. There was some evidence that local inflammation can also be reduced, as within-group analysis showed that the joint protection group had improved swollen hand joint counts at 6 months and there was a strong trend to a significant difference between the groups at 12 months. Failure to reach significance may be because the joint protection group tailed off in their use of joint protection to some extent at 12 months, suggesting that booster sessions might be of benefit. The joint protection group also reduced their duration of early morning stiffness by a third, reported significantly fewer disease flare-ups and visited their doctor less often, indicating that their need for medical care was reduced because they were better able to control symptoms through joint protection.

The effects on physical and functional status were less obvious, although there were differences in ADL and improvements in grip strength and range of movement of the hands. As the subjects were an early-diagnosed group with low AIMS2 scores initially, it may be that the scale had a floor effect and did not easily identify the smaller functional improvements that result from tasks being less difficult when hand joint protection methods were used. The sample size may also have been too small to detect differences

because of low (good) initial scores. Follow-up studies of people with early RA indicate that functional capacity is well preserved in early RA over a 2-yr period and even after 5 or 6 yr [28, 29]. If joint protection does slow physical and functional deterioration, then differences in AIMS2 scores may become more obvious at a longer-term follow-up. Deformity scores continued to increase in both groups, suggesting that joint protection was not helping to slow progression of deformity as claimed. However, the deformity scoring method was simplistic, and a more detailed evaluation of deformity would provide a more definitive answer as to whether joint protection can help slow deformity. Both groups had similar drug therapy regimes and changes, indicating that the benefits obtained were over and above those resulting from drug therapy.

The findings confirmed previous studies [8–10] showing that typical joint protection education (the standard programme) does not result in significant behavioural change for most participants, as only 22% improved their scores. In comparison, 60% did so in the joint protection programme, demonstrating that educational–behavioural teaching methods are more effective when teaching joint protection. Changing health behavior is difficult [30] and changing everyday automatic behaviors (such as turning a tap and lifting a kettle) is even more so, because we all perform such actions at an unconscious level. The joint protection programme focused on helping people become more aware of their movement patterns and pain levels during activity through self-monitoring. This helped participants to become more conscious of these habitual activities and to alter their working methods progressively in ‘bite-sized’ steps through the use of graded practice, goal-setting and homework programmes. Educational–behavioural and cognitive–behavioural approaches have similarly been shown to be more effective in achieving health behavior change in exercise, relaxation and cognitive pain management methods [31–33].

Occupational therapy is a scarce resource and teaching joint protection takes about 25% of a rheumatology occupational therapist's working week [12]. As it has been proven beneficial, it should be provided efficiently and cost-effectively. A suggested option is to provide initially a brief individual introduction to joint protection, supported by an educational booklet. Maggs *et al.* [34] have demonstrated that providing a booklet is just as effective in improving knowledge of arthritis management and joint protection as providing this plus 1 h of individual education from an occupational therapist. This could be further supported by the loan (or purchase) of educational videotapes. The joint protection programme could be offered to those interested in learning more and attending such a programme, in order to focus scarce resources on achieving maximum benefits. Further research is needed to help identify factors that indicate when people with RA are more likely to adhere to joint protection in order to select people, as 40% did not change, even though motivated to attend.

Two-thirds of those referred for the education programmes attended, highlighting their popularity. The standard programme was considered both beneficial and informative by participants. As this design did not include a no-treatment control group, it cannot be inferred that the standard programme was of no benefit. Whether the condition of participants would have declined further without this programme is unknown. There are

other limitations to the study. Some measures may have been insufficiently sensitive to detect change (the AIMS2) in early RA with this sample size. The sample group was inevitably self-selected from those referred and consisted of those willing to attend an education group. They were thus probably a more motivated group. However, this is reflective of clinical practice as it is inevitably those who are more motivated, have fewer family/work responsibilities and can travel easily who attend for out-patient therapy.

In summary, those attending the educational–behavioural joint protection programme gained significant benefits in terms of reduced pain, early morning stiffness and improved ADL ability and assessor and patient ratings of disease status. There was a strong tendency to having fewer swollen joints and better range of movement of the hand joints. Within-group analyses also showed significant improvements in the sense of control of arthritis, self-efficacy and satisfaction with health. These findings indicate that this teaching approach should be more widely adopted to enable more people with RA to gain the benefits of joint protection.

References

1. Brattstrom M. Joint protection—rehabilitation in chronic rheumatic disorders, edn 2. London: Wolfe Medical Publications, 1987.
2. Cordery J. Joint protection: a responsibility of the occupational therapist. *Am J Occup Ther* 1965;19:285–94. [\[Medline\]](#)
3. Cordery J, Rocchi M. Joint protection and fatigue management. In: Melvin J, Jensen G, eds. *Rheumatologic rehabilitation, Vol. 1. Assessment and management*. Bethesda, MD: American Occupational Therapy Association, 1998:279–322.
4. Melvin J. *Rheumatic disease: occupational therapy and rehabilitation*, edn 2. Philadelphia: F.A. Davis, 1989:351–71.
5. Nordenskiold U, Grimby G, Hedberg M, Wright B, Linacre J. The structure of an instrument for assessing the effect of assistive devices and altered working methods in women with rheumatoid arthritis. *Arthritis Care Res* 1996;9:358–67. [\[ISI\]](#) [\[Medline\]](#)
6. Nordenskiold U. Evaluation of assistive devices after a course of joint protection. *Int J Technol Assessment Health Care* 1994;10:293–304.
7. Nordenskiold U, Grimby G, Dahlin-Ivanoff S. Questionnaire to evaluate the effects of assistive devices and altered working methods in women with rheumatoid arthritis. *Clin Rheumatol* 1998;19:6–16.

8. Hammond A. Joint protection behavior in patients with rheumatoid arthritis. *Arthritis Care Res*1994;7:5–9. [\[Medline\]](#)
9. Hammond A, Lincoln N. The effect of a joint protection education programme for people with rheumatoid arthritis. *Clin Rehabil*1999;13:392–400. [\[ISI\]](#)[\[Medline\]](#)
10. Helliwell P, O'Hara M, Holdsworth J, Hesselden A, King T, Evans P. A 12 month randomized controlled trial of patient education on radiographic changes and quality of life in early rheumatoid arthritis. *Rheumatology*1999;38:303–8. [\[Abstract/Free Full Text\]](#)
11. Hill J. A practical guide to patient education and information giving. *Bailliere's Clin Rheumatol*1997;11:109–27.
12. Hammond A. Joint protection education: what are we doing? *Br J Occup Ther*1997;60:401–6.
13. Brus HLM, van der Laar MAFJ, Taal E, Rasker JH. Effects of patient education on compliance with basic treatment regimens and health in recent onset active rheumatoid arthritis. *Ann Rheum Dis*1998;57:146–51. [\[Abstract/Free Full Text\]](#)
14. Hammond A, Lincoln N, Sutcliffe L. A crossover trial evaluating an educational-behavioural joint protection education programme for people with rheumatoid arthritis. *Patient Educ Couns*1999;37:19–32. [\[ISI\]](#)[\[Medline\]](#)
15. Lindroth Y, Bauman A, Barnes C, McCredie M, Brooks PM. A controlled evaluation of arthritis education. *Br J Rheumatol*1989;28:7–12. [\[Abstract/Free Full Text\]](#)
16. Lindroth Y, Bauman A, Brooks PM, Priestleys D. A 5 year follow-up of a controlled trial of an arthritis education programme. *J Rheumatol*1995;34:647–52.
17. Lindroth Y, Brattstrom M, Bellman I *et al.* A problem-based education program for patients with rheumatoid arthritis: evaluation after three and twelve months. *Arthritis Care Res*1997;10:325–32. [\[ISI\]](#)[\[Medline\]](#)
18. Becker MH. *The health belief model and personal health behavior*. New Jersey: Charles B. Slack, 1974.
19. Bandura A. Self-efficacy: towards a unifying theory of behavior change. *Psychol Rev*1977;84:191–215. [\[ISI\]](#)[\[Medline\]](#)
20. Kanfer FH, Gaelick L. Self-management methods. In: Kanfer FH, Goldstein AP, eds. *Helping people change: a textbook of methods*, edn 3. New York: Pergamon Press, 1989.

21. Altman DG. Practical statistics for medical research. London: Chapman & Hall, 1991:87–8.
22. Hammond A, Lincoln N. Development of the Joint Protection Behavior Assessment. *Arthritis Care Res*1999;12:200–7. [\[ISI\]](#)[\[Medline\]](#)
23. Scott DL, van Riel PL, van der Heijde D, Benke AS. Assessing disease activity in rheumatoid arthritis: the EULAR handbook of standard methods.1993.
24. Meenan RF, Mason JH, Anderson JJ, Guccione AA, Kazis LE. AIMS2: the content and properties of a revised and expanded Arthritis Impact Measurement Scales Health Status Questionnaire. *Arthritis Rheum*1992;35:1–10. [\[ISI\]](#)[\[Medline\]](#)
25. Spiegel TM, Spiegel JS, Paulus HE. The Joint Alignment and Motion Scale: a simple measure of joint deformity in patients with rheumatoid arthritis. *J Rheumatol*1987;14:887–92. [\[ISI\]](#)[\[Medline\]](#)
26. Lorig K, Chastain RL, Ung E, Shoor S, Holman HR. Development and evaluation of a scale to measure perceived self-efficacy in people with arthritis. *Arthritis Rheum*1989;32:37–44. [\[ISI\]](#)[\[Medline\]](#)
27. Callahan LF, Brooks RH, Pincus T. Further analysis of learned helplessness in rheumatoid arthritis using a ‘Rheumatology Attitudes Index’. *J Rheumatol*1988;15:418–26. [\[ISI\]](#)[\[Medline\]](#)
28. Eberhardt KB, Rydgren LC, Pettersson H, Wollheim FA. Early rheumatoid arthritis—onset, course and outcome over 2 years. *Rheumatol Int*1990;10:135–42. [\[ISI\]](#)[\[Medline\]](#)
29. Eberhardt KB, Fex E. Functional impairment and disability in early rheumatoid arthritis—development over 5 years. *J Rheumatol*1995;22:1037–42. [\[ISI\]](#)[\[Medline\]](#)
30. Lorish C. Psychological factors related to treatment and adherence. In: Melvin J, Jensen G, eds. Rheumatologic rehabilitation series, Vol. 1. Assessment and management. Bethesda, MD, American Occupational Therapy Association, 1998:39–63.
31. Taal E, Riemsma RP, Brus HLM, Seydey ER, Rasker JJ, Wiegman O. Group education for patients with rheumatoid arthritis. *Patient Educ Couns*1993;20:177–87. [\[ISI\]](#)[\[Medline\]](#)
32. Lorig K, Lubeck D, Kraines RG, Seleznick M, Holman HR. Outcomes of self-help education for patients with arthritis. *Arthritis Rheum*1985;28:680–5. [\[ISI\]](#)[\[Medline\]](#)

33. Barlow J, Turner AP, Wright CC. Long-term outcomes of an arthritis self-management programme. Br J Rheumatol1998;37:1315–9.[\[Abstract/Free Full Text\]](#)
34. Maggs FM, Jubb RW, Kemm JR. Single blind randomized controlled trial of an educational booklet for patients with chronic arthritis. Br J Rheumatol1996;35:775–7.[\[Abstract/Free Full Text\]](#)

Anatomy of the Hand

The hand is composed of many different bones, muscles, and ligaments that allow for a large amount of movement and dexterity. There are three major types of bones in the hand itself, including the following:

- **phalanges** - the 14 bones that are found in the fingers of each hand and also in the toes of each foot. Each finger has three phalanges (the distal, middle, and proximal); the thumb only has two.
- **metacarpal** bones - the five bones that compose the middle part of the hand.
- **carpal bones** - the eight bones that create the wrist. The carpal bones are connected to two bones of the arm, the ulnar bone and the radius bone.

Numerous muscles, ligaments, and sheaths can be found within the hand. The muscles are the structures that can contract, allowing movement of the bones in the hand. The ligaments are fibrous tissues that help bind together the joints in the hand. The sheaths are tubular structures that surround part of the fingers.

Rheumatoid Arthritis Glossary of Terms

Abdominal: Relating to the abdomen, the belly , that part of the body that contains all of the structures between the chest and the pelvis . The abdomen is separated anatomically from the chest by the diaphragm , the powerful muscle spanning the body cavity below the lungs .

Abdominal pain: Pain in the belly (the abdomen). Abdominal pain can come from conditions affecting a variety of organs. The abdomen is an anatomical area that is bounded by the lower margin of the ribs above, the pelvic bone (pubic ramus) below, and the flanks on each side. Although abdominal pain can arise from the tissues of the abdominal wall that surround the abdominal cavity (the skin and abdominal wall muscles), the term abdominal pain generally is used to describe pain originating from organs within the abdominal cavity (from beneath the skin and muscles). These organs include the stomach, small intestine, colon, liver, gallbladder, and pancreas.

Abnormal: Not normal. Deviating from the usual structure, position, condition, or behavior. In referring to a growth, abnormal may mean that it is cancerous or premalignant (likely to become cancer).

Acetaminophen: A pain reliever and fever reducer. Brand name: Tylenol. The exact mechanism of action of [acetaminophen](#) is not known. Acetaminophen relieves pain by elevating the pain threshold (that is, by requiring a greater amount of pain to develop before it is felt by a person). Acetaminophen reduces fever through its action on the heat-regulating center (the "thermostat") of the brain. Generic is available.

Adjacent: Lying nearby. Related terms include [superjacent](#), [subjacent](#), and [circumjacent](#). From [ad-](#), near + the Latin jacere, to lie = to lie near.

Aggressive: In oncology, quickly growing, tending to spread rapidly. As, for example, an aggressive tumor.

Analysis: A psychology term for processes used to gain understanding of complex emotional or behavioral issues.

Anemia: The condition of having less than the normal number of red blood cells or less than the normal quantity of hemoglobin in the blood. The oxygen-carrying capacity of the

Anti-CCP: See: [Citrulline antibody](#).

Anti-citrulline antibody: See: [Citrulline antibody](#).

Anti-cyclic citrullinated peptide antibody: See: [Citrulline antibody](#).

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Antibiotic: A drug used to treat infections caused by bacteria and other microorganisms. Originally, an antibiotic was a substance produced by one microorganism that selectively inhibits the growth of another. Synthetic antibiotics, usually chemically related to natural antibiotics, have since been produced that accomplish comparable tasks.

Antibody: An immunoglobulin, a specialized immune protein, produced because of the introduction of an antigen into the body, and which possesses the remarkable ability to combine with the very antigen that triggered its production.

Antinuclear antibody: An unusual antibody that is directed against structures within the nucleus of the cell. Antinuclear antibodies (ANAs) are found in patients whose immune system is predisposed to cause inflammation against their own body tissues. Antibodies that are directed against one's own tissues are referred to as autoantibodies. The propensity for the immune system to work against its own body is referred to as autoimmunity.

Apheresis: The process of removing a specific component from blood and returning the remaining components to the donor, in order to collect more of one particular part of the blood than could be separated from a unit of whole blood. Also called hemapheresis or pheresis.

Arm: 1. In popular usage, the appendage that extends from the shoulder to the hand. However, the medical definition refers to the upper extremity extending from the shoulder only to the elbow, excluding the forearm, which extends from the elbow to the wrist. The arm contains one bone: the humerus. **2.** In a randomized clinical trial, any of the treatment groups. Most randomized trials have two "arms," but some have three "arms," or even more.

Arthritis: Inflammation of a joint. When joints are inflamed they can develop stiffness, warmth, swelling, redness and pain. There are over 100 types of [arthritis](#). (see [osteoarthritis](#), [rheumatoid arthritis](#), [ankylosing spondylitis](#), [psoriatic arthritis](#), [lupus](#), [gout](#), [pseudogout](#)).

Arthrocentesis: Joint aspiration, a procedure whereby a sterile needle and syringe are used to drain fluid from a joint. This is usually done as an office procedure or at the bedside in the hospital.

Arthroscopy: A surgical technique whereby a tube-like instrument is inserted into a joint to inspect, diagnose and repair tissues. [Arthroscopy](#) is most commonly performed in patients with diseases of the knees or shoulders. The adjective "arthroscopic" is often confused with "orthoscopic." Orthoscopic means having correct vision or producing it; and free from optical distortion or designed to correct distorted vision. This fits with the prefix "ortho-", meaning straight or erect, and "-scopic" from the Greek "skopein", to see. Orthoscopic literally is to see straight. Knee surgery performed with a small scope is arthroscopic knee surgery, not orthoscopic knee surgery.

Aspirin: A good example of a tradename that entered into the language, Aspirin was once the Bayer trademark for acetylsalicylic acid .

Autoimmune: Pertaining to autoimmunity, a misdirected immune response that occurs when the immune system goes awry and attacks the body itself.

Autoimmune disease: An illness that occurs when the body tissues are attacked by its own immune system . The immune system is a complex organization within the body that is designed normally to "seek and destroy" invaders of the body, including infectious agents. Patients with autoimmune diseases frequently have unusual antibodies circulating in their blood that target their own body tissues.

Bacteria: Single-celled microorganisms which can exist either as independent (free-living) organisms or as parasites (dependent upon another organism for life).

Biological response modifiers (BRMs): Substances that stimulate the body's response to infection and disease. The body naturally produces small amounts of these substances. Scientists can produce some of them in the laboratory in large amounts for use in treating cancer , rheumatoid arthritis , and other diseases.

Biotechnology: The fusion of biology and technology. Biotechnology is the application of biological techniques to product research and development. In particular, biotechnology involves the use by industry of recombinant DNA, cell fusion, and new bioprocessing techniques. Biotechnology is expected to become increasingly important in the 21st century.

Blood: The familiar red fluid in the body that contains [white](#) and [red blood cells](#), [platelets](#), [proteins](#), and other elements. The blood is transported throughout the body by the [circulatory system](#). Blood functions in two directions: arterial and venous. Arterial blood is the means by which [oxygen](#) and nutrients are transported to tissues while venous blood is the means by which [carbon dioxide](#) and [metabolic](#) by-products are transported to the [lungs](#) and kidneys, respectively, for removal from the body.

Blood pressure: The blood pressure is the pressure of the [blood](#) within the arteries. It is produced primarily by the [contraction](#) of the [heart muscle](#). It's measurement is recorded by two numbers. The first ([systolic](#) pressure) is measured after the [heart](#) contracts and is highest. The second ([diastolic](#) pressure) is measured before the heart contracts and lowest. A blood pressure cuff is used to measure the pressure. Elevation of blood pressure is called "[hypertension](#)".

Bone: Bone is the substance that forms the skeleton of the body. It is composed chiefly of calcium phosphate and calcium carbonate. It also serves as a storage area for calcium, playing a large role in calcium balance in the blood.

Bone marrow: The soft blood-forming tissue that fills the cavities of bones and contains fat and immature and mature blood cells, including white blood cells, red blood cells, and platelets. Diseases or drugs that affect the bone marrow can affect the total counts of these cells.

Bowel: Another name for the intestine. The small bowel and the large bowel are the small intestine and large intestine, respectively.

Breathing: The process of respiration, during which air is inhaled into the lungs through the mouth or nose due to muscle contraction, and then exhaled due to muscle relaxation.

Bursa: Plural of [bursa](#).

Bursitis: Bursitis is inflammation of a bursa. A bursa is a tiny fluid-filled sac that functions as a gliding surface to reduce friction between tissues of the body. The major bursae are located adjacent to the tendons near the large joints, such as the shoulders, elbows, hips, and knees.

C-reactive protein: A plasma protein that rises in the blood with the inflammation from certain conditions.

Calcium: A mineral found mainly in the hard part of bones, where it is stored. Calcium is added to bones by cells called osteoblasts and is removed from bones by cells called osteoclasts. Calcium is essential for healthy bones. It is also important for muscle contraction, heart action, nervous system maintenance, and normal blood clotting. Food sources of calcium include dairy foods, some leafy green vegetables such as broccoli and collards, canned salmon, clams, oysters, calcium-fortified foods, and tofu. According to the National Academy of Sciences, adequate intake of calcium is 1,200 milligrams a day (four glasses of milk) for men and women 51 and older, 1,000 milligrams a day for adults 19 through 50, and 1,300 milligrams a day for children 9 through 18. The upper limit for calcium intake is 2.5 grams daily.

Cancer: An abnormal growth of cells which tend to proliferate in an uncontrolled way and, in some cases, to metastasize (spread).

Cartilage: Firm, rubbery tissue that cushions bones at joints. A more flexible kind of cartilage connects muscles with bones and makes up other parts of the body, such as the larynx and the outside parts of the ears.

Cell: The basic structural and functional unit in people and all living things. Each cell is a small container of chemicals and water wrapped in a membrane.

Chest: The area of the body located between the neck and the abdomen. The chest contains the lungs, the heart and part of the aorta. The walls of the chest are supported by the dorsal vertebrae, the ribs, and the sternum.

Chest pain: There are many causes of chest pain. One is [angina](#) which results from inadequate oxygen supply to the heart muscle. Angina can be caused by coronary artery disease or spasm of the coronary arteries. Chest pain can also be due to a [heart attack](#) (coronary occlusion) and other important diseases such as, for example, [dissection of the aorta](#) and a [pulmonary embolism](#). Do not try to ignore chest pain and "work (or play) through it." Chest pain is a warning to seek medical attention.

Chronic: This important term in medicine comes from the Greek chronos, time and means lasting a long time.

Chronic disease: A disease that persists for a long time. A chronic disease is one lasting 3 months or more, by the definition of the U.S. National Center for Health Statistics. Chronic diseases generally cannot be prevented by vaccines or cured by medication, nor do they just disappear. Eighty-eight percent of Americans over 65 years of age have at least one chronic health condition (as of 1998). Health damaging behaviors - particularly tobacco use, lack of physical activity, and poor eating habits - are major contributors to the leading chronic diseases.

Cirrhosis: An abnormal liver condition characterized by irreversible scarring of the liver. Alcohol and [viral hepatitis](#) B and C are among the many causes of cirrhosis. Cirrhosis can cause yellowing of the skin ([jaundice](#)), itching, and fatigue. Diagnosis of cirrhosis can be suggested by physical examination and blood tests, and can be confirmed by liver biopsy in some patients. Complications of cirrhosis include mental confusion, coma, fluid accumulation (ascites), internal bleeding, and kidney failure. Treatment of cirrhosis is designed to limit any further damage to the liver as well as complications. Liver transplantation is becoming an important option for patients with advanced cirrhosis.

Citrulline: A non-standard amino acid that is not normally present in protein. Citrulline is created in the body as an intermediate in the conversion of the amino acid ornithine to arginine in a metabolic pathway called the urea cycle.

Citrulline antibody: An antibody (an immune protein) directed against a circular peptide (a ring of amino acids) containing an unusual ("non-standard") amino acid called citrulline that is not normally present in peptides or proteins. (Citrulline is formed by the body as an intermediary in the conversion of the amino acid ornithine to arginine). The citrulline antibody provides the basis for a test of importance in rheumatoid arthritis.

Clinical: **1.** Having to do with the examination and treatment of patients. **2.** Applicable to

Clinical trials: Trials to evaluate the effectiveness and safety of medications or medical devices by monitoring their effects on large groups of people.

Colitis: Inflammation of the large intestine (the colon). There are many forms of colitis, including ulcerative, Crohn's, infectious, pseudomembranous, and spastic. For example, intermittent [rectal bleeding](#), crampy abdominal pain and [diarrhea](#) can be symptoms of [ulcerative colitis](#). Diagnosis can be made by barium enema, but direct visualization (sigmoidoscopy or colonoscopy) is the most accurate test. Long-standing ulcerative colitis increases the risk for colon cancer. Ulcerative colitis can also be associated with inflammation in joints, spine, skin, eyes, the liver and its bile ducts. Treatment of ulcerative colitis can involve medications and surgery.

Collagen: Collagen is the principal protein of the skin, tendons, cartilage, bone and connective tissue.

Complication: In medicine, an additional problem that arises following a procedure, treatment or illness and is secondary to it. A complication complicates the situation.

Connective tissue: A material made up of fibers forming a framework and support structure for body tissues and organs. Connective tissue surrounds many organs. Cartilage and bone are specialized forms of connective tissue. All connective tissue is derived from [mesoderm](#), the middle [germ cell](#) layer in the [embryo](#).

Corticosteroid: Any of the steroid hormones made by the cortex (outer layer) of the adrenal gland. Cortisol is a corticosteroid.

Cortisone: An adrenocorticoid hormone, a naturally occurring hormone made by and secreted by the adrenal cortex, the outer part (the cortex) of the adrenal gland.

Cryoglobulinemia: The presence in blood of abnormal proteins called cryoglobulins that, by definition, have the unusual properties of precipitating from the blood serum when it is chilled and redissolving upon rewarming. (Cryoglobulins are gamma globulins with a molecular weight of approximately 200,000.)

Cure: **1.** To heal, to make well, to restore to good health. Cures are easy to claim and, all too often, difficult to confirm.

2. A time without recurrence of a disease so that the risk of recurrence is small, as in the 5-year cure rate for malignant melanoma.

3. Particularly in the past, a course of treatment. For example, take a cure at a spa.

Cytokine: A small protein released by cells that has a specific effect on the interactions between cells, on communications between cells or on the behavior of cells. The cytokines includes the interleukins, lymphokines and cell signal molecules, such as tumor necrosis factor and the interferons, which trigger inflammation and respond to infections.

Diagnosis: **1** The nature of a disease ; the identification of an illness. **2** A conclusion or decision reached by diagnosis. The diagnosis is rabies . **3** The identification of any problem. The diagnosis was a plugged IV.

Diarrhea : A familiar phenomenon with unusually frequent or unusually liquid bowel movements, excessive watery evacuations of fecal material. The opposite of constipation . The word "diarrhea" with its odd spelling is a near steal from the Greek "diarrhoia" meaning "a flowing through." Plato and Aristotle may have had diarrhoia while today we have diarrhea. There are myriad infectious and noninfectious causes of diarrhea.

Disease: Illness or sickness often characterized by typical patient problems (symptoms) and physical findings (signs). Disruption sequence: The events that occur when a fetus that is developing normally is subjected to a destructive agent such as the rubella (German [measles](#)) virus.

Drain: A device for removing fluid from a cavity or wound. A drain is typically a tube or wick.

Environment: The sum of the total of the elements, factors and conditions in the surroundings which may have an impact on the development , action or survival of an organism or group of organisms.

Enzyme: A protein (or protein-based molecule) that speeds up a chemical reaction in a living organism. An enzyme acts as catalyst for specific chemical reactions , converting a specific set of reactants (called substrates) into specific products. Without enzymes, life as we know it would not exist.

Enzymes: Proteins that act as a catalysts in mediating and speeding a specific chemical reaction .

Erosion: An erosion is an eating away of a surface. ("Erodere" in Latin means to eat out.)

Eye: The organ of sight. The eye has a number of components. These components include but are not limited to the cornea, iris, pupil, lens, retina, macula, optic nerve, choroid and vitreous.

Family: 1. A group of individuals related by blood or marriage or by a feeling of closeness. **2.** A biological classification of related plants or animals that is a division below the order and above the genus. **3.** A group of genes related in structure and in function that descended from an ancestral gene. **4.** A group of gene products similarly related in structure and function and of shared genetic descent. **5.** Parents and their children. The most fundamental social group in humans.

Fatigue: A condition characterized by a lessened capacity for work and reduced efficiency of accomplishment, usually accompanied by a feeling of weariness and tiredness. Fatigue can be acute and come on suddenly or chronic and persist.

Feet: The plural of foot, both an anatomic structure and a unit of measure.

Fever : Although a fever technically is any body temperature above the normal of 98.6 degrees F. (37 degrees C.), in practice a person is usually not considered to have a significant fever until the temperature is above 100.4 degrees F (38 degrees C.).

Fungi: Plural of [fungus](#).

Gastrointestinal: Adjective referring collectively to the stomach and small and large intestines.

Gene: The basic biological unit of heredity . A segment of deoxyribonucleic acid (DNA) needed to contribute to a function.

Gene array analysis: A way of analyzing the differential expression of thousands of species of mRNA (messenger RNA) at the same time in two different samples (as, for example, in normal vs. tumor tissue, or at different developmental stages). Gene array analysis involves synthesizing labeled cDNA (complementary DNA) from 2 or more sources, and hybridizing them to identical gene arrays. This procedure can be done in standard molecular biology laboratories with basic instrumentation.

Genetic: Having to do with genes and genetic information.

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Gout: Condition characterized by abnormally elevated levels of uric acid in the blood, recurring attacks of joint inflammation ([arthritis](#)), deposits of hard lumps of uric acid in and around the joints, and decreased kidney function and [kidney stones](#). Uric acid is a breakdown product of purines, that are part of many foods we eat. The tendency to develop [gout](#) and elevated blood uric acid level (hyperuricemia) is often inherited and can be promoted by [obesity](#), weight gain, alcohol intake, [high blood pressure](#), abnormal kidney function, and drugs. The most reliable diagnostic test for gout is the identification of crystals in joints, body fluids and tissues.

Hair loss : Hair loss is the thinning of hair on the scalp. The medical term for hair loss is alopecia . Alopecia can be temporary or permanent. The most common form of hair loss occurs gradually and is referred to as “androgenetic alopecia,” meaning that a combination of hormones (androgens are male hormones) and heredity (genetics) is needed to develop the condition. Other types of hair loss include alopecia areata (patches of baldness that usually grow back), telogen effluvium (rapid shedding after childbirth, fever , or sudden weight loss); and traction alopecia (thinning from tight braids or ponytails).

Health: As officially defined by the World Health Organization, a state of complete physical, mental, and social well-being, not merely the absence of disease or infirmity.

Heart: The muscle that pumps blood received from veins into arteries throughout the body. It is positioned in the chest behind the sternum (breastbone; in front of the trachea, esophagus, and aorta; and above the diaphragm muscle that separates the chest and abdominal cavities. The normal heart is about the size of a closed fist, and weighs about 10.5 ounces. It is cone-shaped, with the point of the cone pointing down to the left. Two-thirds of the heart lies in the left side of the chest with the balance in the right chest.

High blood pressure : Also known as hypertension, high blood pressure is, by definition, a repeatedly elevated blood pressure exceeding 140 over 90 mmHg -- a systolic pressure above 140 with a diastolic pressure above 90.

Ibuprofen: A non-steroidal anti-inflammatory drug (NSAID) commonly used to treat pain, swelling, and [fever](#). Common brand names for [Ibuprofen](#) include Advil, Motrin, and Nuprin.

IL-1: [Interleukin-1](#).

Immune: Protected against infection. The Latin immunis means free, exempt.

Immune system: A complex system that is responsible for distinguishing us from everything foreign to us, and for protecting us against infections and foreign substances. The immune system works to seek and kill invaders.

Immunosuppressive: 1. Pertaining to immunosuppression , the suppression of the immune system .
2. An agent capable of suppressing the immune response .

Infection: The growth of a parasitic organism within the body. (A parasitic organism is one that lives on or in another organism and draws its nourishment therefrom.) A person with an infection has another organism (a "germ") growing within him, drawing its nourishment from the person.

Inflammation: A basic way in which the body reacts to infection , irritation or other injury, the key feature being redness, warmth, swelling and pain . Inflammation is now recognized as a type of nonspecific immune response .

Interleukin-1: A protein produced by various cells, including macrophages, interleukin-1 raises body temperature, spurs the production of [interferon](#), and stimulates growth of disease-fighting cells, among other functions. Abbreviated IL-1.

Intervention: The act of intervening, interfering or interceding with the intent of modifying the outcome. In medicine, an intervention is usually undertaken to help treat or cure a condition. For example, early intervention may help children with [autism](#) to speak. "Acupuncture as a therapeutic intervention is widely practiced in the United States," according to the National Institutes of Health. From the Latin *intervenire*, to come between.

Joint: A joint is the area where two bones are attached for the purpose of motion of body parts. A joint is usually formed of fibrous connective tissue and cartilage. An articulation or an arthrosis is the same as a joint.

Kidney: One of a pair of organs located in the right and left side of the abdomen which clear "poisons" from the blood, regulate acid concentration and maintain water balance in the body by excreting urine. The kidneys are part of the urinary tract. The urine then passes through connecting tubes called "ureters" into the bladder. The bladder stores the urine until it is released during urination.

Knee: The knee is a joint which has three parts. The thigh bone (the femur) meets the large shin bone (the tibia) to form the main knee joint. This joint has an inner (medial) and an outer (lateral) compartment. The kneecap (the patella) joins the femur to form a third joint, called the patellofemoral joint. The patella protects the front of the knee joint.

Laboratory: A place for doing tests and research procedures and preparing chemicals, etc. Although "laboratory" looks very like the Latin "laboratorium" (a place to labor, a work place), the word "laboratory" came from the Latin "elaborare" (to work out, as a problem, and with great pains), as evidenced by the Old English spelling "elaboratory" designating "a place where learned effort was applied to the solution of scientific problems."

Leg: In popular usage, the leg extends from the top of the thigh down to the foot. However, in medical terminology, the leg refers to the portion of the lower extremity from the knee to the ankle.

Liver: An organ in the upper abdomen that aids in digestion and removes waste products and worn-out cells from the blood. The liver is the largest solid organ in the body. The liver weighs about three and a half pounds (1.6 kilograms). It measures about 8 inches (20 cm) horizontally (across) and 6.5 inches (17 cm) vertically (down) and is 4.5 inches (12 cm) thick.

Liver disease: Liver disease refers to any disorder of the liver. The liver is a large organ in the upper right abdomen that aids in digestion and removes waste products from the blood.

Lungs: The lungs are a pair of breathing organs located with the chest which remove carbon dioxide from and bring oxygen to the blood. There is a right and left lung.

Lymph: An almost colorless fluid that travels through vessels called lymphatics in the lymphatic system and carries cells that help fight infection and disease.

Lymphoma: Tumor of the lymphoid tissue. Diagnosis is by biopsy. Treatment may be [chemotherapy](#), radiation, surgery, or medication, depending on the age of the patient and type of tumor.

Malaria : An infectious disease caused by protozoan parasites from the Plasmodium family that can be transmitted by the sting of the Anopheles mosquito or by a contaminated needle or transfusion. Falciparum malaria is the most deadly type.

Marrow: The [bone marrow](#).

Medication: 1. A drug or medicine. **2.** The administration of a drug or medicine. (Note that "medication" does not have the dangerous double meaning of "drug.")

Methotrexate : A drug that acts as an antimetabolite and specifically as a folic acid antagonist that inhibits the synthesis of DNA , RNA , and protein .

Minocin: Brand name for [minocycline](#).

Minocycline: A tetracycline antibiotic used to treat many different bacteria in urinary tract infections, acne , gonorrhea , and chlamydia , and other infections. The brand names for minocycline include Dynacin, Minocin, and Vectrin.

Mouth: 1. The upper opening of the digestive tract, beginning with the lips and containing the teeth, gums, and tongue. Foodstuffs are broken down mechanically in the mouth by chewing and saliva is added as a lubricant. Saliva contains amylase, an enzyme that digests starch. **2.** Any opening or aperture in the body. The mouth in both senses of the word is also called the os, the Latin word for an opening, or mouth. The o in os is pronounced as in hope. The genitive form of os is oris from which comes the word oral.

Muscle: Muscle is the tissue of the body which primarily functions as a source of power. There are three types of muscle in the body. Muscle which is responsible for moving extremities and external areas of the body is called "skeletal muscle." Heart muscle is called "cardiac muscle." Muscle that is in the walls of arteries and bowel is called "smooth muscle."

Nail: In medicine, there are two types of nails. One is just a plain old metal nail used to hold 2 or more pieces of bone together, for example, after a fracture. The other type of nail is the horny plate on the end of the finger or toe. Each nail anatomically has a body, lateral nail folds (on the sides), a lunula (the little moon-shaped feature at the base), and a proximal skin fold (at the base).

Naprosyn: See: [Naproxen](#).

Naproxen : A non-steroidal anti-inflammatory drug (NSAID) used for the management of mild to moderate pain, fever, and inflammation . Naproxen blocks the enzyme cyclooxygenase that makes prostaglandins, resulting in lower concentrations of prostaglandins. As a consequence, inflammation, pain and fever are reduced. Brand names for naproxen include Anaprox, Naprelan, Naprosyn, and Aleve.

Necrosis: The death of living cells or [tissues](#). Necrosis can be due, for example, to [ischemia](#) (lack of blood flow). From the Greek "nekros" (dead body).

NSAID: Nonsteroidal anti-inflammatory drug. NSAIDs are commonly prescribed for the inflammation of arthritis and other body tissues, such as in tendinitis and bursitis . Examples of NSAIDs include aspirin, indomethacin (Indocin), ibuprofen (Motrin), naproxen (Naprosyn), piroxicam (Feldene), and nabumetone (Relafen).

Onset: In medicine, the first appearance of the signs or symptoms of an illness as, for example, the onset of rheumatoid arthritis . There is always an onset to a disease but never to the return to good health. The default setting is good health.

Ophthalmologist: An eye doctor. A physician practicing ophthalmology. An ophthalmologist is an M.D.

Osteoporosis: Thinning of the bones with reduction in bone mass due to depletion of calcium and bone protein . Osteoporosis predisposes a person to fractures, which are often slow to heal and heal poorly. It is more common in older adults, particularly post-menopausal women; in patients on steroids; and in those who take steroidal drugs. Unchecked osteoporosis can lead to changes in posture , physical abnormality (particularly the form of hunched back known colloquially as " dowager's hump "), and decreased mobility.

Pain: An unpleasant sensation that can range from mild, localized discomfort to agony. Pain has both physical and emotional components. The physical part of pain results from nerve stimulation. Pain may be contained to a discrete area, as in an injury, or it can be more diffuse, as in disorders like fibromyalgia . Pain is mediated by specific nerve fibers

that carry the pain impulses to the brain where their conscious appreciation may be modified by many factors.

Peptide: A molecule consisting of 2 or more amino acids. Peptides are smaller than proteins, which are also chains of amino acids. Molecules small enough to be synthesized from the constituent amino acids are, by convention, called peptides rather than proteins. The dividing line is at about 50 amino acids. Depending on the number of amino acids, peptides are called dipeptides, tripeptides, tetrapeptides, and so on.

Pericarditis: Inflammation of the lining around the heart (the pericardium) causing chest pain and accumulation of fluid around the heart (pericardial effusion).

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Plasma: The liquid part of the blood and lymphatic fluid, which makes up about half of its volume. Plasma is devoid of cells and, unlike serum, has not clotted. Blood plasma contains antibodies and other proteins. It is taken from donors and made into medications for a variety of blood-related conditions. Some blood plasma is also used in non-medical products.

Platelet: An irregular, disc-shaped element in the blood that assists in blood clotting. During normal blood clotting, the platelets clump together (aggregate). Although platelets are often classed as blood cells, they are actually fragments of large bone marrow cells called megakaryocytes.

Platelet count: The calculated number of platelets in a volume of blood, usually expressed as platelets per cubic millimeter (cmm) of whole blood. Platelets are the smallest cell-like structures in the blood and are important for blood clotting and plugging damaged blood vessels. Platelet counts are usually done by laboratory machines that also count other blood elements such as the white and red cells. They can also be counted by use of a microscope. Normal platelet counts are in the range of 150,000 to 400,000 per microliter (or $150 - 400 \times 10^9$ per liter). These values may vary slightly between different laboratories.

Pleuritis: Inflammation of the pleura. When the pleura becomes inflamed, it can produce more than the normal amount of fluid, causing a pleural effusion.

Pregnancy: The state of carrying a developing embryo or fetus within the female body. This condition can be indicated by positive results on an over-the-counter urine test, and confirmed through a blood test, ultrasound, detection of fetal heartbeat, or an X-ray. Pregnancy lasts for about nine months, measured from the date of the woman's last menstrual period (LMP). It is conventionally divided into three trimesters, each roughly three months long.

Progressive: Increasing in scope or severity. Advancing. Going forward. In medicine, a disease that is progressive is going from bad to worse.

Protein: A large molecule composed of one or more chains of amino acids in a specific order determined by the base sequence of nucleotides in the DNA coding for the protein.

Quinine: The original antimalarial agent, quinine took its name from the Peruvian Indian word "kina" meaning "bark of the tree" referring to the cinchona tree. From this tree, quinine was first obtained. The Peruvian Indians called it "the fever tree."

Radioactive: Emitting energy waves due to decaying atomic nuclei. Radioactive substances are used in medicine as tracers for diagnosis, and in treatment to kill cancerous cells.

Range: In medicine and statistics, the difference between the lowest and highest numerical values. For example, if five premature infants are born weighing two, three, four, four, and five pounds respectively, the range of their birth weights is two to five pounds.

Rash : Breaking out (eruption) of the skin. Medically, a rash is referred to as an exanthem.

Receptor: 1. In cell biology, a structure on the surface of a cell (or inside a cell) that selectively receives and binds a specific substance. There are many receptors. There is a receptor for (insulin ; there is a receptor for low-density lipoproteins (LDL); etc. To take an example, the receptor for substance P, a molecule that acts as a messenger for the sensation of pain , is a unique harbor on the cell surface where substance P docks. Without this receptor, substance P cannot dock and cannot deliver its message of pain. Variant forms of nuclear hormone receptors mediate processes such as cholesterol metabolism and fatty acid production. Some hormone receptors are implicated in diseases such as diabetes and certain types of cancer. A receptor called PXR appears to jump-start the body's response to unfamiliar chemicals and may be involved in drug-drug interactions.

2. In neurology, a terminal of a sensory nerve that receives and responds to stimuli.

Red blood cells: The blood cells that carry oxygen. Red cells contain hemoglobin and it is the hemoglobin which permits them to transport oxygen (and carbon dioxide). Hemoglobin, aside from being a transport molecule, is a pigment. It gives the cells their red color (and their name).

Relapse: The return of signs and symptoms of a disease after a patient has enjoyed a remission . For example, after treatment a patient with cancer of the colon went into remission with no sign or symptom of the tumor, remained in remission for 4 years, but then suffered a relapse and had to be treated once again for colon cancer.

Remission: Disappearance of the signs and symptoms of cancer or other disease. When this happens, the disease is said to be "in remission." A remission can be temporary or permanent.

Rest: 1. Repose. Relaxation.

2. A fragment of embryonic tissue that has been retained after the period of embryonic development. Also called an embryonic rest.

Rheumatoid arthritis : An autoimmune disease which causes chronic inflammation of the joints, the tissue around the joints, as well as other organs in the body. Autoimmune diseases occur when the body tissues are mistakenly attacked by its own immune system. The immune system is a complex organization of cells and antibodies designed normally to "seek and destroy" invaders of the body, particularly infections. Patients with these diseases have antibodies in their blood which target their own body tissues, where they can be associated with inflammation. Because it can affect multiple other organs of the body, rheumatoid arthritis is referred to as a systemic illness and is sometimes called rheumatoid disease. While rheumatoid arthritis is a chronic illness (meaning it can last for years) patients may experience long periods without symptoms.

Rheumatoid factor: Rheumatoid factor is an antibody that is measurable in the blood. It is commonly used as a blood test for the diagnosis of rheumatoid [arthritis](#). Rheumatoid factor is present in about 80% of adults (but a much lower proportion of children) with [rheumatoid arthritis](#). It is also present in patients with other connective tissue diseases (such as [systemic lupus erythematosus](#)) and in some with infectious diseases (such as infectious hepatitis).

Rheumatoid nodules: Rheumatoid nodules are firm lumps in the skin of patients with [rheumatoid arthritis](#) that usually occur in pressure points of the body, most commonly the elbows

Rheumatologist: A specialist in the non-surgical treatment of rheumatic illnesses, especially arthritis .

Sedimentation rate : A blood test that detects and monitors inflammation in the body. It measures the rate at which red blood cells (RBCs) in a test tube separate from blood

serum over time, becoming sediment in the bottom of the test tube. The sedimentation rate increases with more inflammation. Also called the erythrocyte sedimentation rate. Abbreviated as sed rate or ESR.

Side effects: Problems that occur when treatment goes beyond the desired effect. Or problems that occur in addition to the desired therapeutic effect.

Skin: The skin is the body's outer covering. It protects us against heat and light, injury, and infection. It regulates body temperature and stores water, fat, and vitamin D. Weighing about 6 pounds, the skin is the body's largest organ. It is made up of two main layers; the outer epidermis and the inner dermis.

Spleen: An organ located in the upper left part of the abdomen near the stomach . The spleen produces lymphocytes ; it is the largest lymphatic organ in the body. The spleen also filters the blood, serves as a major reservoir for blood and destroys blood cells that are aged.

Stomach: 1. The sac-shaped digestive organ that is located in the upper abdomen, under the ribs. The upper part of the stomach connects to the esophagus, and the lower part leads into the small intestine.

Stress: Forces from the outside world impinging on the individual. Stress is a normal part of life that can help us learn and grow. Conversely, stress can cause us significant problems.

Substance: 1. Material with particular features, as a [pressor substance](#).
2. The material that makes up an [organ](#) or structure. Also known in medicine as the substantia.
3. A psychoactive drug as, for example, in [substance abuse](#).

Surgery: The word "surgery" has multiple meanings. It is the branch of medicine concerned with diseases and conditions which require or are amenable to operative procedures. Surgery is the work done by a surgeon. By analogy, the work of an editor wielding his pen as a scalpel is s form of surgery. A surgery in England (and some other

Symptomatic: 1 With symptoms, as a symptomatic [infection](#). **2** Characteristic, as behavior symptomatic of [Huntington disease](#). **3** Directed at the symptoms, as [symptomatic treatment](#).

Syndrome: A set of signs and symptoms that tend to occur together and which reflect the presence of a particular disease or an increased chance of developing a particular disease.

Synovial fluid: The slippery fluid that lubricates joints and provides nutrients to the cartilage. Also known as the synovia.

Synovitis: Inflammation of the synovial membrane, the lining of the joint.

Syringe: A device used in medicine to inject fluid into or withdraw fluid from the body. Medical syringes consist of a needle attached to a hollow cylinder that is fitted with a sliding plunger. The downward movement of the plunger injects fluid; upward movement withdraws fluid.

Systemic: Affecting the entire body. A systemic disease such as diabetes can affect the whole body. Systemic chemotherapy employs drugs that travel through the bloodstream and reach and affect cells all over the body.

Taste: Taste belongs to our chemical sensing system, or the chemosenses. The complicated process of tasting begins when molecules released by the substances stimulate special cells in the mouth or throat. These special sensory cells transmit messages through nerves to the brain where specific tastes are identified.

Tendinitis: Inflammation of a tendon (the tissue by which muscle attaches to bone). Tendinitis most commonly occurs as a result of injury, such as to the tendons around the shoulder or elbow. It can also occur as a result of an underlying inflammatory rheumatic disease, such as [reactive arthritis](#) or [gout](#). Tendinitis is synonymous with tendonitis.

Tetracycline: A family of broad-spectrum antibiotics effective against a remarkably wide variety of organisms. Bacteria susceptible to tetracycline include H. flu (Hemophilus influenzae), strep (Streptococcus pneumoniae), Mycoplasma pneumoniae, Chlamydia psittaci, Chlamydia trachomatis, and Neisseria gonorrhoeae (the cause of gonorrhea). Tetracycline is also used to treat nongonococcal urethritis (due to Ureaplasma), Rocky mountain spotted fever, typhus, chancroid, cholera, brucellosis, anthrax, and syphilis. It is used in combination with other medications to treat Helicobacter pylori, the bacteria associated with ulcers of the stomach and duodenum.

Therapy: The treatment of disease.

Tissue: A tissue in medicine is not like a piece of tissue paper. It is a broad term that is applied to any group of cells that perform specific functions. A tissue in medicine need not form a layer. Thus,

- The bone marrow is a tissue;
- Connective tissue consists of cells that make up fibers in the framework supporting other body tissues; and
- Lymphoid tissue is the part of the body's immune system that helps protect it from bacteria and other foreign entities.

Tobacco: A South American herb, formally known as *Nicotiana tabacum* , whose leaves contain 2-8% nicotine and serve as the source of smoking and smokeless tobacco .

Toilet: **1.** In medicine, cleansing of a wound and the skin around it. **2.** In obstetrics, cleansing of a woman just after childbirth. **3.** In dentistry, the cleaning out of a cavity before a restoration. **4.** A device for the disposal of urine and feces. Or the room containing such a device.

Topical: Pertaining to a particular surface area. A topical agent is applied to a certain area of the skin and is intended to affect only the area to which it is applied. Whether its effects are indeed limited to that area depends upon whether the agent stays where it is

Total hip replacement : Surgery in which the diseased ball and socket of the hip joint are completely removed and replaced with artificial materials. A metal ball with a stem (a prosthesis) is inserted into the femur (thigh bone) and an artificial plastic cup socket is placed in the acetabulum (a "cup-shaped" part of the pelvis .

Total knee replacement: A surgical procedure in which damaged parts of the knee joint are replaced with artificial parts.

Trigger: Something that either sets off a disease in people who are genetically predisposed to developing the disease, or that causes a certain symptom to occur in a person who has a disease. For example, sunlight can trigger rashes in people with [lupus](#).

Tumor: An abnormal mass of tissue. Tumors are a classic sign of inflammation, and can be benign or malignant (cancerous). There are dozens of different types of tumors. Their names usually reflect the kind of tissue they arise in, and may also tell you something about their shape or how they grow. For example, a medulloblastoma is a tumor that arises from embryonic cells (a blastoma) in the inner part of the brain (the medulla). Diagnosis depends on the type and location of the tumor. Tumor marker tests and imaging may be used; some tumors can be seen (for example, tumors on the exterior of

the skin) or felt (palpated with the hands).

Tumor necrosis factor: A member of a superfamily of proteins , each with 157 amino acids, which induce necrosis (death) of tumor cells and possess a wide range of proinflammatory actions. Tumor necrosis factor is a multifunctional cytokine with effects on lipid metabolism , coagulation , insulin resistance, and the function of endothelial cells lining blood vessels.

Tylenol: See: [Acetaminophen](#).

Ulcer: An area of tissue erosion, for example, of the skin or lining of the gastrointestinal (GI) tract. Due to the erosion, an ulcer is concave. It is always depressed below the level of the surrounding tissue.

Ulcerative colitis : A relatively common disease that causes inflammation of the large intestine (the colon). The cause is unknown.

Urine: Liquid waste. The urine is a clear, transparent fluid. It normally has an amber color. The average amount of urine excreted in 24 hours is from 40 to 60 ounces (about 1,200 cubic centimeters). Chemically, the urine is mainly an aqueous (watery) solution of salt (sodium chloride) and substances called urea and uric acid. Normally, it contains about 960 parts of water to 40 parts of solid matter. Abnormally, it may contain sugar (in diabetes), albumen (a protein) (as in some forms of kidney disease), bile pigments (as in [jaundice](#)), or abnormal quantities of one or another of its normal components.

Vasculitis: Plural: vasculitides. A general term for a group of diseases that feature inflammation of the blood vessels. Each of these diseases is defined by characteristic distributions of blood vessel involvement, patterns of organ involvement, and laboratory test abnormalities. The causes of these vasculitis diseases are usually not known, but immune system abnormality is a common feature.

Vein: A blood vessel that carries blood low in oxygen content from the body back to the heart. The deoxygenated form of hemoglobin (deoxyhemoglobin) in venous blood makes it appear dark. Veins are part of the afferent wing of the circulatory system which returns blood to the heart.

Vessel: A tube in the body that carries fluids: blood vessels or lymph vessels.

Viruses: Small living particles that can infect cells and change how the cells function. Infection with a virus can cause a person to develop symptoms. The disease and symptoms that are caused depend on the type of virus and the type of cells that are infected.

Vitamin D: A steroid vitamin which promotes the intestinal absorption and metabolism of calcium and phosphorus . Under normal conditions of sunlight exposure, no dietary supplementation is necessary because sunlight promotes adequate vitamin D synthesis in the skin. Deficiency can lead to bone deformity (rickets) in children and bone weakness (osteomalacia) in adults.

Wasting: 1. Gradual loss (for example, of weight), deterioration, emaciation. As in a wasting disease. **2.** Excessive depletion. As in salt wasting, the excessive loss of salt.

Wrist: The proximal segment (the near part) of the hand consisting of the carpal bones and the associated soft parts.

X-ray: 1. High-energy radiation with waves shorter than those of visible light. X-rays possess the properties of penetrating most substances (to varying extents), of acting on a photographic film or plate (permitting radiography), and of causing a fluorescent screen to give off light (permitting fluoroscopy). In low doses X-rays are used for making images that help to diagnose disease, and in high doses to treat cancer . Formerly called a Roentgen ray. **2.** An image obtained by means of X-rays.

Post Test

1. Hand therapy is a merging of occupational therapy and physical therapy theory and practice that combines comprehensive knowledge of the upper quarter, body function, and activity.
 - a. True
 - b. False

2. The American Society of Hand Therapists was incorporated in _____ to advance the specialty of hand therapy through communication, education, research and the establishment of clinical standards.
 - a. 1957
 - b. 1967
 - c. 1977
 - d. 1987

3. When joints are inflamed or active, therapists should not have patients do not perform resistive exercises.
 - a. True
 - b. False

4. Normally a joint consists of two smooth, cartilage-covered bone surfaces that fit together as a matched set and that move smoothly against one other. Arthritis results when these smooth surfaces become irregular and don't fit together well anymore and essentially "wear out."
 - a. True
 - b. False

5. The most common forms of arthritis in the hand are osteoarthritis, post-traumatic arthritis (after an injury), and rheumatoid arthritis. Other causes of arthritis of the hand are _____.
 - a. infection
 - b. gout
 - c. psoriasis
 - d. All of the above

6. Arthritis can affect any joint in the body, but it is most noticeable when it affects the hands and fingers.

a. True

b. False

7. Each hand has _____ bones, plus 8 small bones and the two forearm bones that form the wrist.

a. 14

b. 17

c. 19

d. 21

8. Rheumatoid arthritis (RA) affects the cells that line and normally lubricate the joints (synovial tissue).

a. True

b. False

9. RA is a systemic condition (can affect the whole body), which means that it may affect multiple joints, usually on both sides of the body.

a. True

b. False

10. Rheumatoid arthritis of the hand is most common in the _____.

a. feet and toe knuckles

b. wrist and the finger knuckles

c. shoulder and bursa

d. None of the above

11. In treating RA, physicians may recommend _____, and instruction on how to use your hands in ways that may help relieve pain and pressure and also protect the joints. Adaptive devices may help cope with the activities of daily living.

- a. a hand therapist for exercises
- b. splints
- c. modalities such as paraffin (warm wax) baths
- d. All of the above

12. There is no cure for rheumatoid arthritis.

- a. True
- b. False

13. RA decreases some motor performance functions of the hand expressed as _____, and coordination.

- a. simple reaction time
- b. choice reaction time
- c. speed of movement
- d. All of the above

14. In the study reviewed in the course, the patients with RA were slower than the controls in the speed of movement tests. This finding might be mainly a consequence of unpleasant feelings of pain or fear of pain during movements.

- a. True
- b. False

15. The study's coordination test (modified Fitts' task) involves a type of visually guided motor response, which is an essential component of a wide variety of skills needed for daily work and recreation.

- a. True
- b. False

16. When the study's coordination results were analyzed in detail, it was noted that the mean values of speed of movement, in particular, were lower in the patients with RA. Thus it seems that the decrease in total coordination is caused mainly by a decrease in the speed of movement component.

- a. True
- b. False

17. The study concluded that the condition of the larger joints, such as the shoulder and the elbow joints, have an important role in the fast movements and the total performance of the hand in patients with RA.

- a. True
- b. False

18. There were no correlations between the motor performance tests and the VAS score, the KFT score, grip strength, disease duration, and the number of swollen joints. This finding was partly expected because the age range of the group of rheumatoid patients (33-75 years) was so wide.

- a. True
- b. False

19. However, it should be noted that the speed of movement (lateral direction) correlated with the number of tender joints of the hands, and the speed of movement of the right hand tended to correlate with the total KFT score of the arm.

- a. True
- b. False

20. Joint protection aims to _____.

- a. reduce pain and local inflammation
- b. preserve the integrity of joint structures
- c. improve function
- d. All of the above

21. Joint protection can help slow the progression of the effects of RA over and above the effects of drug therapy.

- a. True
- b. False

22. Joint protection is widely provided as part of the management of people with rheumatoid arthritis (RA). Altering working methods, energy conservation (balancing rest and activity) and using assistive devices should place less strain on joint structures weakened by the disease process.

- a. True
- b. False

23. Research has demonstrated that using assistive devices reduces pain during task performance in comparison with normal methods.

- a. True
- b. False

24. Theoretically, reducing load and the effort required to do everyday tasks should lead to _____.

- a. less irritation of the synovium
- b. less pressure on pain receptors
- c. reduction of localized inflammation
- d. All of the above

25. Whether people with RA increase their use of joint protection sufficiently to affect pain, inflammation, the integrity of joint structures and function in the longer term is unknown.

- a. True
- b. False

26. People with RA are generally not very positive about receiving such advice.

- a. True
- b. False

27. _____: Firm, rubbery tissue that cushions bones at joints.

- a. Osteoblast
- b. Bursa
- c. Cartilage
- d. None of the above

28. The citrulline antibody provides the basis for a test of importance in rheumatoid arthritis.

- a. True
- b. False

29. _____ is the principal protein of the skin, tendons, cartilage, bone and connective tissue.

- a. The cell
- b. Collagen
- c. Cryoglobulin
- d. None of the above

30. Inflammation is now recognized as a type of nonspecific immune response.

- a. True
- b. False

Anatomy of the Hand

