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Muscleworks: A Computer-Assisted Study Tool for Muscle Function and Anatomy

Neil H. Otto
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MUSCLEWORKS: A COMPUTER-ASSISTED STUDY TOOL
FOR MUSCLE FUNCTION AND ANATOMY

by

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Bachelor of Science in Physical Therapy
University of North Dakota, 1993

An Independent Study
Submitted to the Graduate Faculty of the
Department of Physical Therapy
School of Medicine
University of North Dakota
in partial fulfillment of the requirements
for the degree of
Master of Physical Therapy

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1993
This Independent Study, submitted by Neil H. Otto in partial fulfillment of the requirements for the Degree of Master of Physical Therapy from the University of North Dakota, has been read by the Faculty Preceptor, Advisor, and Chairperson of Physical Therapy under whom the work has been done and is hereby approved.

Peggy M. Mohr
(Faculty Preceptor)

(Graduate School Advisor)

[Signature]
(Chairperson, Physical Therapy)
PERMISSION

Title MUSCLEWORKS: A COMPUTER-ASSISTED STUDY TOOL FOR MUSCLE ANATOMY AND FUNCTION

Department Physical Therapy

Degree Masters of Physical Therapy

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Signature ____________________________

Date ____________________________
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ABSTRACT

This independent study report reviews the advantages and disadvantages of computer assisted instruction (CAI), the criteria for justifying CAI development and examples of CAI in anatomy. Basic information regarding representative software packages is provided. A detailed description of MuscleWorks, the author's Appleworks-based data base of the muscular system is given, which includes justification, applications, and step-by-step instructions for most effective use. Sample questions and answers are provided. Printouts of each screen display utilized in the given examples are also furnished.

The author concludes that no other software package closely resembling MuscleWorks is currently being marketed, and that use of the software could enhance the ease and efficiency of anatomy study by physical therapy students.

The author recommends that the package be upgraded to a stand-alone program, and be expanded to run on IBM and Macintosh family machines.
RATIONALE

The effective study of the muscular system, including its gross anatomy and detailed function, is an area of prime concern to physical therapy instructors and students alike.

Snell\textsuperscript{1} states that, "The first day that you look at or place your hand on a patient, you require a basic knowledge of anatomy to interpret your observations." A therapist who lacks clear and precise knowledge of this subject matter will likely be less than maximally effective in his treatment. Saunders\textsuperscript{2} points out that, "No longer can a physical therapist practice without a proper data base from which to plan the treatment of a musculoskeletal problem."

Armed with a comprehensive knowledge of the muscles, their origins, insertions, innervations, and actions, a therapist can distinguish among strength problems, joint problems, and neurological problems. With an accurate evaluation of the problem, an effective treatment program can then be undertaken. If, for example, a patient were to present with pain at the elbow, a thorough knowledge of anatomy would allow the therapist to quickly differentiate between a musculoskeletal problem at that site and a nerve impingement.
problem at a distant location. In a case such as this, the treatment plans would be quite different.

With the advent of the personal computer, a new tool has been added to the resources of the anatomy student and instructor. Using the computer, a student now has access to vast amounts of information, and the ability to organize that information into a useful form. Entire medical libraries may be searched for needed references. Instructors can assemble banks of practice questions for his or her students. Almost any process from "cellular mitosis" to "continental drift" can be simulated and displayed. Animated dissection programs allow the user to strip away layer after layer of tissue to view the innermost workings of the human body.

Computer-assisted instruction (CAI) in the health sciences is now well into its third decade. In 1972, there were 124 colleges and universities using CAI in their health sciences curriculums.³

CAI is viewed differently by various authorities on the subject. Billings⁴ and Rubin⁵ list time saving as a major objective of CAI, while Deland⁶ states that, "... it is intended more to expand the spectrum of possible educational approaches than to reduce the role of the human teacher." Wakefield, et al,⁷ cite the need to cut down on the flood of printed material, and the lead time needed to produce it.

Some advantages of CAI include learner control, immediate feedback, privacy, and accessibility. Disadvantages include development time and costs,
a limited repertoire of instructional strategies, and a limited range of media features. In order to justify the investments of time and money needed to overcome or accommodate for the disadvantages of CAI, some specific criteria must be met. A number of these factors are described by Brigham, and are discussed in the following paragraphs.

There must be a large number of potential users with similar needs if software development is to be cost effective. Even considering the authoring software now available, CAI development is quite time intensive, and such an investment in a small user market is usually not warranted.

There must be a potential for speeding up instruction. This can be either student time, instructor time, or both. Training programs and continuing education are instances which often support CAI use.

The content of the material must be stable. Frequent revisions of the software content not only are time consuming, but will increase the risk of errors. This advisement also applies to material which is in the early stages of research and is not as yet basic knowledge for a large group of people.

Large scale CAI is expensive, involving the purchase and maintenance of hardware as well as software. Therefore, provisions to allocate funding for a continued commitment to CAI should be made at the outset, if the program is to be utilized at the optimum level.

Additionally, the learners must have access to the system. Location, staffing and support should be arranged before implementation is attempted.
The learners, faculty, and administrators must have a positive, or at least accepting, attitude towards CAI. The feelings of the people involved should be ascertained, and provisions for any necessary additional training made before implementation.³

The importance of the nonaccepting attitude toward CAI is pointed out in research by Rubin, et al,⁹ in which only 39% of surveyed students felt that their use of CAI was worthwhile, while the remainder described it in such terms as "frustrating," "time-consuming," and "impersonal."

No attempt is made in this paper to evaluate the efficacy of CAI, beyond noting the two following studies which are inconclusive on the subject. A study by Walsh and Bohn⁹ involving 151 first-year medical students showed that students felt their CAI lessons to be useful (mean of 1.8 on a 1-10 scale with 1 being most useful), but that there was no significant improvement in their test scores as compared to the scores of those students not using CAI.

In contrast, another study conducted at Ohio State University by Frisby and Guy,¹⁰ attempted to compare students who had used only CAI lessons with students who had participated in a traditional cadaver lab. Two hundred fifty students participated in the study. Both groups were tested on cadavers. The cadaver group achieved a mean score of 50.17 with a range of 28-60 on the final exam, compared to the CAI group which scored at a mean of 50.98 with a range of 37-60. In their analysis, the authors utilized a t-test at the .05 level of significance. It was concluded that there were no significant differences in
learning outcomes when students utilized interactive videodisc lessons instead of the traditional cadaver demonstrations.

The majority of the instructional software reviewed fell into one of the following categories as defined by Billings:4

- Drill & Practice
- Tutorial
- Simulation
- Problem Solving
- Model Building
- Testing

Additionally, most of the CAI packages available in catalogs focused around computer generated graphics. Some, like Gross Anatomy Review Program (GARP),11 allowed the student to do on-screen dissections, while others were animated to illustrate function. All required some degree of enhanced capability in the hardware, such as graphics cards, or additional disk drives. Two examples of CAI are described in the following paragraphs.

A fairly typical example of CAI packages for Anatomy instruction is the GARP11 developed by Anne Moch and David Nathan, medical students at the University of Pennsylvania. Included within GARP are pictures of simplified dissections with labelled structures and accompanying text. Students are able to dissect and remove structures from view and replace them in order to review spatial relationships. GARP also incorporates a self-quiz system. At present,
GARP only covers the thorax and abdomen. A survey of students showed that 90% used GARP, and 99% of users favor expanding it to cover the rest of the body.

On a greater scale of complexity is Animated Dissection of Anatomy,\textsuperscript{12} authored and produced by ADAM software, Inc. of Marietta Georgia. ADAM is a compact disc read only memory (CD-ROM) based animated dissection program which allows the student or instructor to strip away layers of tissue on the screen, obtain microscopic views, and access textual information on any structure presented on screen. Images can be modified and saved to compile a special-use, personalized library. At present, only the lower extremities and thoracic modules are available, with upper extremities, head, and neck modules due to be released in April of 1993. No efficacy or user surveys are currently available.

The formats of these and other program packages most often emphasize reinstruction or computer generated practice questions over a given portion of the material, or a combination of both techniques. They are, in essence, computerized textbooks, rather than question answering devices.\textsuperscript{4} Appendix A presents essential information regarding available software packages which are most representative of those investigated as part of the literature review.\textsuperscript{13,14} The literature review failed to reveal any software packages designed to: 1) answer specific, user generated questions, and 2) which would run on a personal computer with no after-market enhancements.
This study views CAI as a learning tool, used by the student, rather than as a teaching tool with the instructor as the prime director and motivator. Since the resources of most undergraduate students are limited, the package is designed to run on computers which are unenhanced. No attempt is made to address video disk, hypercard, or CD ROM media.

Finding the answers to specific, though frequently very simple, anatomical questions was found by the author to be cumbersome and time consuming. For example, suppose one needs a list of all muscles served by the median nerve. Using Snell's Clinical Anatomy for Medical Students, the index reveals seven page listings under "Nerves, median," but no full list of the muscles served. It is then necessary to look up all the individual muscles of the forearm and hand (there are over 20), and find all those innervated by the median nerve. An easier way might be to consult a set of flash cards of the muscular system. The Muscles, authored by Andrew Bonsall, contains one hundred sixty cards, with a subcategory of twenty eight cards for the forearm and hand, which must be examined individually to compile the required list.

The goal of this project is to produce an alternative means of answering specific user-generated questions relating to muscular anatomy. It is the author's intention to provide a data base file which may be used on personal computers with no after market enhancements. This data base will meet a large number of the previously discussed criteria for cost effective CAI development. The time saving potential of MuscleWorks has already been
discussed. The following paragraphs deal with the other justification issues for CAI development.

It should be readily apparent that the pool of potential MuscleWorks users is equal to the number of anatomy students who own personal computers. Access to the necessary hardware is also guaranteed in this way.

Most of the basic research in gross anatomy was completed by the end of the nineteenth century, and the content is now quite stable, thus lending itself as an ideal content area for CAI. Since, at this point in its development, MuscleWorks is intended for free distribution to interested parties for use on computers which they already own, funding is not an issue. Those who own personal computers commonly have an accepting attitude toward computers in general, and indeed are usually looking for potential new uses for their machines. Therefore, it should be clear that muscular anatomy is an excellent field for development of CAI, and that MuscleWorks is a worthwhile effort in this area.
DESIGN

MuscleWorks is a data base document (set of data) written using the AppleWorks Integrated Software (c) package published by Claris. It is intended for use by anatomy students to answer specific questions about the human muscular system.

The primary source of information contained in the data base is The Muscles by Bonsall, published by Flash Anatomy of Santa Ana, California. Additional sources are Snell's Clinical Anatomy for Medical Students and lecture notes from Arnold Keck of the University of North Dakota. Categories of information are:

- Name of muscle
- Origin
- Insertion
- Innervation
- Spinal cord segment or cranial nerve innervation
- Primary action
- Secondary Action
- Group & Location
Information in the data base can be deleted, added, or modified to fit the specific needs of the user. Since textbooks and instructors occasionally fail to agree in regard to some aspects of muscular anatomy, it is highly recommended that each muscle record be checked by the student as it is presented in class to make sure that it is in agreement with your particular text and instructor.

Hardware

MuscleWorks requires an Apple II GS, IIe, or IIc, or compatible computer with at least 128K of RAM memory, and at least one 3.5" or 5.25" disk drive. There is no need for a color monitor or expanded graphics capability. A printer is useful for generating hard copies of lists, but is not required to make good use of the software.

Operating system

MuscleWorks uses the ProDos 8 V 1.4(c) disc operating system.

Application

MuscleWorks is designed as a data base to be used with Appleworks (c) versions 1.2 or later. Documentation is provided for use with Appleworks version 2.0.

Data Base

MuscleWorks is a data base document occupying 31K of RAM memory, and containing 146 records, each record comprised of 8 fields.
Categorical Information

Field 1: Name - Includes the complete anatomical name of a single muscle or a group of muscles that are usually not considered individually. An example of the latter type is the Rotatores Longus. There are 23 muscles on each side of the spine, so the name is followed by (23). Since most muscle groups are bilaterally symmetrical; i.e., the same on each side, only one side is considered. For example, each leg has a Rectus Femoris, but the name is not followed by (2). Occasionally two muscles have the same name, such as the Abductor Digiti Minimi, which appear in both the hand and foot. A search for this name will produce two records.

Field 2: Origin - Names the more fixed end or attachment or attachments of the muscle. In most cases, a specific portion of the bone of origin is described. Example: Quadratus Femoris - Medial side greater trochanter of Femur. In cases of muscles with two or more heads attaching to different bones, both bones are named, and as complete a description of the area of origin as space allows.

Field 3: Insertion - Names the site of attachment of the muscle to the bone or other tissue which it moves. A search of insertions, however, will not always yield the bone which is primarily affected. In the case of the Gracilis, the muscle's primary action is femoral adduction, but the muscle does not attach to the femur.
Field 4: Innervation - Names the nerve or nerves which innervate the muscle. In most cases only the primary nerve is named. Example: The Extensor Digitorum is served by the posterior interosseous or deep branch of the radial nerve, but innervation is simply listed as radial. In the case of sets of muscles innervated by many nerves, such as the rotatores, the innervation field simply states "Spinal nerves". Cranial nerves are referred to both by name and roman numeral.

Field 5: Segment - Names the spinal segment from which innervation is derived. In most cases one to three spinal segments are named, but when a group of muscles with multiple levels of spinal innervation are involved, the field is left blank.

Field 6: Primary Action - Names the main action of the muscle when it acts alone. Example: The Scalenus Medius, acting alone will laterally flex and rotate the neck to the opposite side. Wherever possible, the attempt was made to name both the joint and body segment affected. Example: The Biceps Brachii acts to flex the forearm at the elbow, so a search for muscles acting on either the forearm or elbow will yield this muscle record.

Field 7: Secondary Action - Names less obvious or less important actions of a muscle when acting alone. Also named are the actions of a group of muscles which often act bilaterally to produce a different action than they would if acting alone. In the Scalenus Medius example above, the secondary
action occurring, if both left and right muscles are active, is extension of the neck and elevation of the 1st rib.

Field 8: Group & Location - Group names the general group to which a muscle belongs, such as muscles of respiration. The group and location are separated by a period. Location gives the general anatomical area where the muscle bellies are located, regardless of action or attachment. Thus a search for muscles of the thigh will include the Gracilis, even though it has no attachment on the femur. The group allows an alphabetical sort of the muscles into their general groupings so that all the hand intrinsics, for example, can be kept together.
USE

Precautions

Make a backup copy of the MuscleWorks database before attempting to use it. It is not copy protected, and can be manipulated or transferred just like any other Appleworks document. It is fairly easy to inadvertently destroy the data accidentally, so MAKE A BACKUP NOW.

The easiest way to lose part of the data base is to do a sort to find only the records you need, and then save the file without first restoring the records you threw out. The only time you should save the file is when you have made changes to the basic information in the records to make them agree with your particular text or instructor.

Startup

Start the computer using the Appleworks Startup disk. Depending on your version of Appleworks, this may or may not be a separate disk.

Flip or change disks from the startup disk to the program disk, press return or enter dates as requested on the screen until the Main Menu screen appears with "Add Files to the Desktop" highlighted.

Press RETURN or ENTER to choose this menu item. This produces the "Add Files" menu.
You now must tell the computer where the MuscleWorks data base file is located. It may be on the same disk you used to load Appleworks, in which case you just press RETURN or ENTER, and MuscleWorks will appear before you, ready to use. If it is located on a different disk, you must insert the disk, choose "A Different Disk" from the "Add Files" menu, and press RETURN. You must then use the "Change Current Disk" menu to choose the proper location of the file, and press RETURN. If you have MuscleWorks on your hard drive, or in some other folder or subdirectory, you must follow the system procedures for your unique configuration.

Manipulating Information

The following is a complete list of keystrokes used to manipulate information in the data base, along with a description of what each does. This list can be brought up at any time by holding the APPLE key and pressing the question mark.

The @ sign is used to represent the APPLE key on the keyboard, so the notation @C means that you are to hold the APPLE key down as you would the SHIFT key, while striking the C key. This gives the COPY command. These are similar to the function key commands used with IBM compatibles.

Appleworks Data Base Commands

@A - Arrange (sort) this category. Used to put information in alphabetical or numerical order.

@C - Copy records. Includes cut & paste.
@D - Delete records.
@F - Find all records that contain . . . .
@I - Insert new records before the current record.
@L - Layout. Changes how the records are displayed.
@M - Move records. Cut & paste.
@N - Name. Change name of whole file, or add, delete, change categories.
@P - Print reports.
@R - Rules. Change record selection rules.
@V - Values. Set or remove standard values for a category.
@Z - Zoom in on 1 record or Zoom out to see multiple records.
@" - Copy entry directly above in multiple record layouts.

RETURN - Enter or accept.
TAB - Go to next category.
@TAB - Go back to previous category.
Up/Down Arrows - Go up or down.
@1 through @9 - Go to beginning or end of file. Example: @5 moves you to the middle of the file.

Conducting a Search

This section will explain in detail and give exact keystrokes for several sample searches, progressing from simple sorts of a single field to more complex extractions involving up to the maximum of 3 fields at once. Selected
output from each example is presented in Appendix B. Each example begins with a realistic question to be answered. All examples begin from the point following startup when MuscleWorks appears on the screen.

Example 1: What is the origin of the Rectus Femoris?

The keystrokes required for this search, separated by commas, are given below. The symbols <> enclosing a word indicate that this word is to be typed on the keyboard.

@Z, @F, <RECTUS FEMORIS>, RETURN.

@Z - zooms in on single record format so you can examine all information on a single muscle.
@F - Produces the FIND RECORDS screen. The cursor is at the bottom of the screen adjacent to the instruction to type comparison information.
RECTUS FEMORIS - Enter the name, any phrase, or group of letters you wish to find. The data base will be searched for all occurrences of that exact grouping of characters.
RETURN - Starts the search, and produces the REVIEW/ADD/CHANGE screen with the complete record of the Rectus Femoris muscle displayed.

Example 2: What muscles have their origin on the Femur?

In this case, a search for the term Femur is not appropriate, since it will yield all muscles which attach to or move the femur. To answer this question, you must set up a search for records where the word Femur appears only in the ORIGIN field.
Keystrokes:

@R, DOWN ARROW, RETURN, DOWN ARROW, RETURN, <FEMUR>,
RETURN, ESCAPE.

@R - Produces the SELECT RECORDS screen, with the MUSCLE field
highlighted.

DOWN ARROW - Moves the marker down the list of fields. Stop when ORIGIN
is highlighted.

RETURN - Selects ORIGIN as the field you wish to search. A list of selection
rules is now shown.

DOWN ARROW - Moves the marker down. Stop at number 7, "contains."

RETURN - Selects "contains" as a second rule for your search. The cursor is
now at the bottom of the screen behind the instruction to type comparison
information.

FEMUR - Completes the rules for your search.

RETURN - Enters Femur as a rule for your search. The rules you have
specified appear at the top left of the screen. The AND and OR options allow
you to specify more rules, but in this case, they are not needed.

ESCAPE - Ends the rule selection, initiates the search, and produces the
REVIEW/ADD/CHANGE screen with a list of the 6 muscles which originate on
the femur.

EXAMPLE 3: What muscles produce wrist ulnar deviation?
This question requires a search of both the primary actions field and the secondary actions field. Since we do not care in which field "ulnar deviation" appears, we will use "or" to specify that either is acceptable.

Keystrokes:

@R, DOWN ARROW, RETURN, DOWN ARROW, RETURN, <ULNAR DEV>, RETURN, DOWN ARROW, RETURN, DOWN ARROW, RETURN, <ULNAR DEV>, RETURN, ESCAPE.

@R - Produces the SELECT RECORDS screen with the MUSCLE field highlighted.

DOWN ARROW - Moves the marker down the list of fields. Stop when PRIMARY ACTION is highlighted.

RETURN - Selects PRIMARY ACTION as a field to be searched. The list of selection rules is now shown.

DOWN ARROW - Moves the marker down. Stop when #7, CONTAINS is highlighted.

RETURN - Selects CONTAINS as a selection rule. The cursor is now at the bottom of the screen with the instruction to type comparison information.

ULNAR DEV - Specifies a search of the PRIMARY ACTIONS field for this exact set of characters and spaces. Shortening deviation to DEV allows "deviate", "deviation", and "deviates" to be chosen in the search.
RETURN - Enters ULNAR DEV as a rule for your search. The and/or options allow for more selection rules.

DOWN ARROW - Highlights "or" as a selection rule.

RETURN - Selects "or" as a selection rule. A list of all 8 fields is again displayed. You can now set the rules for the search of secondary actions.

DOWN ARROW - Moves the marker. Highlight SEC. ACTIONS.

RETURN - Selects SEC. ACTIONS as the field to be searched. The list of selection options is shown.

DOWN ARROW - Moves the marker down. Stop at CONTAINS.

RETURN - Selects CONTAINS as a search rule.

ULNAR DEV - Specifies a search for this character sequence in the SEC. ACTIONS field.

RETURN - Enters ULNAR DEV as a selection rule.

ESC - Starts the search. The specified rules now are:

PRIMARY ACTION contains ULNAR DEV

or

SEC. ACTIONS contains ULNAR DEV

The records matching the search are displayed; in this case, the Flexor Carpi Ulnaris and the Extensor Carpi Ulnaris.
DISCUSSION & RECOMMENDATIONS

During the development of MuscleWorks, several problems became evident. Most of these arose from limitations imposed by the Appleworks integrated software package. Perhaps the most significant was the limitation of each field to a single line of information. This made it impossible in some cases to include a full and complete description of a muscle and its actions. The resultant entries sometimes were so truncated as to be unclear.

Searches also tended to give null or incomplete results. The problem was usually traceable to records which did not contain the exact arrangement of characters specified in the search. For example, a search for "MEDIAL FEMORAL ROTATION" would not yield any results since this action was always described as "MEDIALLY ROTATES FEMUR". The net result was that a new user must spend considerable time experimenting with the program in order to become familiar with its conventions in order to be sure of getting usable information.

When searches were conducted, the Appleworks software package allowed sorting by three rules connected by the logical descriptors "and" and "or". However, if the first two rules were connected by "and", then the third rule must also have used "and." Likewise, if the first two rules were connected by
"or", the third would have had to use "or". This eliminates the ability to conduct many useful searches.

MuscleWorks is not a "stand alone" package. It requires Appleworks software to function, and is currently incompatible with other such packages. This has effectively limited potential users to owners of Apple II compatible computers, which are not common in the world of higher education.

Since the program does not automatically return to a selection of all records at the completion of a search, doing a search and then saving the file to disk can result in the complete loss of most of the data base. Hence the emphasis in Chapter 3 on making a backup copy.

Positive aspects of the program include the increased speed with which detailed information can be located, and ease in narrowing the spread of information to useful proportions. The ability to transfer text from the data base quickly into the word processor is also useful when preparing lesson plans or handouts.

Even taking into consideration all the shortcomings of MuscleWorks, this author has concluded that it is better than the alternative traditional study methods involving textbooks and flash cards. The data base will not give all the answers, but it will reduce the possibilities to a manageable size, and hence may merit continued improvement. Therefore, MuscleWorks may be considered a first step in the process of evolving a truly useful study tool for muscular anatomy.
It is recommended that the following research and development be carried out before MuscleWorks is considered for widespread use:

a) Expansion to allow use on MacIntosh and IBM compatible computers.

b) Development into a stand-alone package which does not require the use of another software package to operate.

c) Additional research to establish efficacy of the program's use.

d) Expansion of data manipulating and storage capabilities to allow for more full descriptions and improved sorting characteristics.
Representative Samples of Currently Available Instructional Software

Title: DYNAMICS OF HUMAN ANATOMY 17
Author: D. Barlow, R. Neeves, K. Handling, K. Troutman
Type: tutorial, drill and practice, simulation, interactive videodisk.
Hardware Req.: M-motion card or InfoWindow emulator, mouse, videodisk player, speaker, amplifier.
Cost: not published

Title: MEDICAL GROSS ANATOMY QUIZ AND STUDY STACKS 18
Author: L. Wright
Type: tutorial, exam, drill and practice
Hardware Req.: hard drive
Cost: $100-$500 depending on number of sites

Title: BACKAID SOFTWARE 19
Author: Brainbank, Inc.
Type: tutorial
Hardware Req.: IBM hard drive, Apple 2 floppy drives
Cost: $99

Title: ATLAS-plus (ADVANCED TOOLS FOR LEARNING ANATOMICAL STRUCTURE) 20
Author: Dept. of Cell Biology of the University of Michigan Medical School
Type: hypermedia
Hardware Req.: Macintosh II class machine or greater.
Cost: Two color monitors, two color graphics cards.

Title: ANATOMY OF THE ARM 21
Author: A. Fedinec, J. Wilson, J. Hahn
Type: tutorial, exam
Hardware Req.: Macintosh Plus or better with hard drive
Cost: $85

Title: A.D.A.M. (ANIMATED DISSECTION OF ANATOMY)\textsuperscript{12}
Author: A.D.A.M. Software Inc.
Type: tutorial, exam
Hardware Req.: EGA, VGA, 1 floppy drive
Cost: $2300-$3750 depending on version

Title: MUSCLE MECHANICS: A COMPUTER-SIMULATED EXPERIMENT\textsuperscript{22}
Author: J. Michael
Type: simulation
Hardware Req.: graphics card (not Hercules)
Cost: $50

Title: ANATOMY PROJECT\textsuperscript{23}
Author: Medical College of Georgia, Center for Clinical Anatomy
Type: tutorial, interactive videodisc
Hardware Req.: Infowindow or 2-screen, videodisc, monitor.
Cost: not published

Note: References for items used in this appendix are listed in the references section.
APPENDIX B
### MuscleWorks opening screen: Table format

<table>
<thead>
<tr>
<th>MUSCLE</th>
<th>ORIGIN</th>
<th>INSERTION</th>
<th>INNERVATION</th>
<th>SEG</th>
</tr>
</thead>
<tbody>
<tr>
<td>External Abdominal Oblique</td>
<td>Ribs 5 6 7 8 9 Linea alba, ing Intercostal ner -</td>
<td></td>
<td>Spinal nerves T7</td>
<td></td>
</tr>
<tr>
<td>Internal Abdominal Oblique</td>
<td>Inguinal ligame Pubic crest, il Iliohypogastric</td>
<td></td>
<td>Spinal nerves T5</td>
<td></td>
</tr>
<tr>
<td>Rectus Abdominis</td>
<td>Pubic crest &amp; s Xiphoid process</td>
<td></td>
<td>Spinal nerves C2</td>
<td></td>
</tr>
<tr>
<td>Sternocleidomastoid</td>
<td>Manubrium &amp; med Mastoid process</td>
<td></td>
<td>Spinal accessor C2</td>
<td></td>
</tr>
<tr>
<td>ScaIenus Anterior</td>
<td>Transverse proc Superior surfac</td>
<td></td>
<td>Spinal nerves C4</td>
<td></td>
</tr>
<tr>
<td>ScaIenus Medius</td>
<td>Transverse proc Superior surfac</td>
<td></td>
<td>Spinal nerves C3</td>
<td></td>
</tr>
<tr>
<td>Brachialis</td>
<td>Lower 1/2 anter Tuberosity and</td>
<td></td>
<td>Musculocutaneou C5</td>
<td></td>
</tr>
<tr>
<td>Pronator Teres</td>
<td>Medial epicondy Middle 1/3 of</td>
<td></td>
<td>Musculocutaneou C6</td>
<td></td>
</tr>
<tr>
<td>Biceps BrachiI</td>
<td>Scapula, Long Radial tuberosi</td>
<td></td>
<td>Musculocutaneou C5</td>
<td></td>
</tr>
<tr>
<td>Brachioradialis</td>
<td>Upper lateral s Styloid process</td>
<td></td>
<td>Radial C5</td>
<td></td>
</tr>
<tr>
<td>Triceps BrachiI</td>
<td>Long Head-Infra Olecranon proc</td>
<td></td>
<td>Radial C6</td>
<td></td>
</tr>
<tr>
<td>Anconeous</td>
<td>Lateral epicond Olecranon proc</td>
<td></td>
<td>Radial C7</td>
<td></td>
</tr>
<tr>
<td>Supinator</td>
<td>Later epicondy Proximal 1/3 of</td>
<td></td>
<td>Radial C5</td>
<td></td>
</tr>
<tr>
<td>Longus Capitis</td>
<td>Transverse proc Basilar portion</td>
<td></td>
<td>Spinal nerves C1</td>
<td></td>
</tr>
<tr>
<td>Longus Colli</td>
<td>C1 C2 C3 C4 C5 C2 C3 C4 C5 C6</td>
<td></td>
<td>Spinal nerves C2</td>
<td></td>
</tr>
</tbody>
</table>

Type entry or use 9 commands  9-? for Help
File: MUSCLEWORKS  FIND RECORDS  Escape: Review/Add/Change

Find all records that contain RECTUS FEM
Press 9-F to change Find.

Record 61 of 146

===================================================================================================
MUSCLE: Rectus Femoris
ORIGIN: Anterior inferior iliac spine & Upper brim of acetabulum
INSERTION: Patella & tibial tuberosity
INNERVATION: Femoral
SEGMENT: L2 L3 L4
PRIMARY ACTION: Extend knee
SEC. ACTIONS: Flex femur at hip
GROUP & LOC.: Hip, thigh & knee. Anterior thigh, Quadriceps

===================================================================================================

Type entry or use 9 commands 9-? for Help

Find Records Screen from Example 1: Label format
File: MUSCLEWORKS
SELECT RECORDS
Escape: Review/Add/Change

Selection:

=================================================================
1. MUSCLE
2. ORIGIN
3. INSERTION
4. INNERVATION
5. SEGMENT
6. PRIMARY ACTION
7. SEC. ACTIONS
8. GROUP & LOC.

=================================================================
Type number, or use arrows, then press Return

First Select Records screen from Example 2
File: MUSCLEWORKS  
Selection: ORIGIN

-----------------------------------------------
1. equals  
2. is greater than  
3. is less than  
4. is not equal to  
5. is blank  
6. is not blank  
7. contains  
8. begins with  
9. ends with  
10. does not contain  
11. does not begin with  
12. does not end with

-----------------------------------------------
Type number, or use arrows, then press Return  1076K Avail.

Second Select Records Screen from Example 2
File: MUSCLEWORKS
SELECT RECORDS
Escape: Review/Add/Change

Selection: ORIGIN contains FEMUR

1. and
2. or

Type number, or use arrows, then press Return 1076K Avail.

Third Select Records Screen from Example 2
**File: MUSCLEWORKS**

**REVIEW/ADD/CHANGE**

**Escape: Main Menu**

Selection: ORIGIN contains FEMUR

<table>
<thead>
<tr>
<th>MUSCLE</th>
<th>ORIGIN</th>
<th>INSERTION</th>
<th>INNERVATION</th>
<th>SEG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vastus Intermedius</td>
<td>Anterior surface Top of patella Femoral</td>
<td>Femoral</td>
<td>L2</td>
<td></td>
</tr>
<tr>
<td>Popliteus</td>
<td>Lateral condyle Posterior Tibia Tibial</td>
<td>Lateral patella Femoral</td>
<td>L4</td>
<td></td>
</tr>
<tr>
<td>Vastus Lateralis</td>
<td>Linea Aspera of Lateral patella Femoral</td>
<td>Posterior Tibia Tibial</td>
<td>L2</td>
<td></td>
</tr>
<tr>
<td>Gastrocnemius</td>
<td>Posterior Femur Calcaneus, Achi Tibial</td>
<td>Calcaneus</td>
<td>S1</td>
<td></td>
</tr>
<tr>
<td>Plantaris</td>
<td>Supracondyler I Calcaneus</td>
<td>Tibial S1 S2</td>
<td>S1</td>
<td></td>
</tr>
</tbody>
</table>

Type entry or use 9 commands  

9-? for Help

Review/Add/Change Screen showing answers from Example 2
REFERENCES


