



RAAViewer

RAAVIEWER MANUAL

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Introduction – Radiologic Anatomy Atlas

RAAViewer is currently under active development. I encourage people to send their comments and suggestions. If you find features of the program confusing, drop me a line. I may be able to help you and others by making the manual clearer.

There are, no doubt, errors in the atlas images themselves with structures incorrectly labeled or misspelled labels. There is considerable data included about the anatomic terms that accompanies the program. Much of that information may be outdated or wrong. Anatomy terminology is confusing and ambiguous in that many synonyms commonly exists for anatomic structures and various sources can refer to what are actually different structures with the same name. The normal variability of human anatomy from one individual to the next compounds the issue. Many of the sources for this program, while having the advantage of being in the public domain are not up to date. Any help with these issues would be appreciated.

The nature of RAAViewer is such that correcting such errors is easy, but I have to know about them. Please drop me an email when you run across such things.

ANY such feedback is appreciated and will be acted upon.

Currently, there is a moderate selection of image folders available. I will be expanding on this and will strive to update the site every few months so check back later for updates and additional image folders.

I would like even more to have people send me high quality images or illustrations of some area of anatomic interest that they would like to include in RAAViewer. These pictures have to be in the public domain or owned by

the provider; I cannot use, without permission, material copied from journals or books that is protected by copyright.

If you send the pictures and indicate how they are labeled then I can include them in the Atlas. Your contribution will be acknowledged.

In this program, the labels are not embedded in the picture. The labels are created in the program and applied to the image as a separate “layer”. This allows modification in the future. If you submit pictures, it is best to send high quality images in a digital format that are not “pre-labeled”. You can send a separate set of labeled images, however you wish, to inform me how the images *should* be labeled. I would do the final labeling in the program.

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History

RAAViewer was inspired in part by a web site of J. H. Edmund Lee, M.D. (<http://homepage.mac.com/frankdcat/mri_atlas/home.html>). What Dr. Lee did was to make a QuickTime movie of labeled MRI images of musculoskeletal structures seen with various imaging sequences and in various planes. The radiologist faced with a piece of anatomy that is unfamiliar can use the controls embedded in QuickTime to move to the relevant frame in the movie and thus find the anatomic structure in question with its label. Standard paper-based anatomy textbooks might have a picture of the anatomy near where you are looking, but, inevitably, you often find that the actual cross-section that you are looking at does not correspond to the handful of images contained in a textbook. Dr. Lee's approach took advantage of storage capacity of a computer to overcome this limitation.

Expanding his approach to other areas, I wrote a primitive program that would look sequentially at all the images in a folder. I then made a number of folders and filled them with related images that I labeled with anatomic terms. This works fine, but has some problems. The major problem is that labeling 30 images in a sequence of MRI images is incredibly tedious and, in my hands, fraught with error. Writing Rhomboideus Major 30 times on 30 different pictures is painful. I would label all these images and then later I would find misspellings and incorrect label positionings, and this would be difficult to correct.

RAAViewer handles this by containing a master database of anatomic terms and their descriptions. These terms can be applied to any image. In this sense, the labels and their associated metadata are separate from the

image, which has many advantages. The image can be flipped without the labels being flipped and thus becoming unreadable. The image can be shrunk down without the labels becoming too small to read. And the labels can be edited without fussing with the pictures themselves.

Synopsis

The images in RAAViewer have dots on them. The user clicks on a dot and the anatomic term that corresponds with that dot is displayed. If there is additional information about the anatomic term, the term is displayed in blue letters. The term itself can then be clicked on and this additional information viewed. This is the heart of the program. It is not a complicated program to use and barely qualifies to have a manual at all.

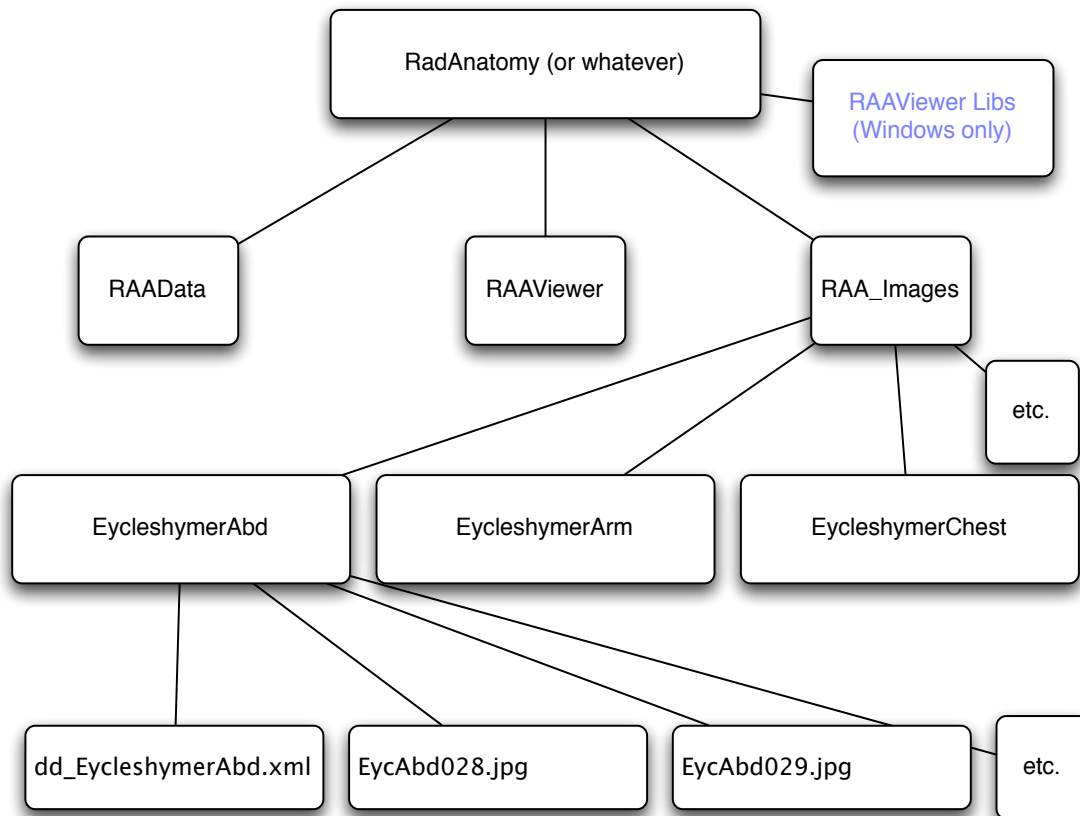
Installation

There are three file/folders that are included with the Macintosh version of RAAViewer. The Windows version requires an additional folder – RAAViewer Libs. They should ALL be placed in a single master folder. That master folder might be named something like RadiologyAnatomyAtlas. You can name the master folder anything that you want and put it any place you want on your machine. You *should not*, however, change the files that are contained within that master folder.

Inside that master folder/directory go all the files that are needed for this program.

1. RAAViewer – the program itself
2. RAADData – a file that contains the anatomic terms and data about them
3. RAA_Images – a folder/directory that contains any number of subfolders. These subfolders contain the images that are used in the program. Each subfolder contains a related set of images. When you use RAAViewer, you select one of these subfolders from within the program to allow you to see the images in that folder.
4. RAAViewer Libs (Windows version only)

This set-up is simple. But you have to keep these three things (or four things for the Windows version) all in the same folder for the program to work. The names of the three (four) file/folders cannot be changed. Similarly, do not change the names or delete individual images from the subfolders. Doing so will frustrate the program.



The program is downloaded as a compressed file, a zip file for Windows and a dmg file for Macintosh. Uncompress this file and the program will be ready to run. If you want to get rid of RAAViewer, just take the master folder and put it in the trash. Almost everything is contained in the master folder.

The one exception is that the program creates a small file that serves as its “memory”. This is not a critical file and if it is lost or deleted, the program will just create another copy. That file remembers such things as recently selected files and the preferred language. That file is named RAAMemory. For Macintosh, it is created in the folder ~\Library\Application

Support\RAAViewer. For Windows, it is created in the folder ~\Application
Data\RAAViewer

Bugs

Non-trivial programs generally have bugs. Therefore I am sure that this one does. Additionally, I cannot guarantee the accuracy of the output of this program. Let the user beware. If you miss a question on your final exam in Anatomy because of RAAViewer, let it be a learning experience and tell me about it.

Having said this, I am interested in squashing any bugs and content errors. If you see any anomalous (incorrect) results or strange behaviors when you are doing things that seem rational, please notify me so I can correct or clarify the situation.

Computer Interface Terminology

This manual strives to be consistent in how it refers to the various widgets that are used to specify the user's intents.

DOT

Most of the images in the program have **dots** on them. You click on the **dot** to reveal the anatomic information contained in the **dot**.

DOT OPACITY SLIDER

The **dots** can be made more or less conspicuous by use of this **dot opacity slider**. There is potential for a dot to obscure the anatomy over which it lies. This slider addresses that problem.

ORIENTATION BUTTONS

There are four buttons that allow the user to orient the image in various ways.

1. Flip the image around a horizontal axis (turn a right leg image into a left leg image)
2. Flip the image around a vertical axis (supine to prone)
3. Rotate the image 90 degree clockwise or counter clockwise.

Clicking on any of these buttons with the Shift key held down will return the picture to its original orientation.

IMAGE SELECTION CONTROL

There may be many images in the **image subfolder** currently being viewed. This control can be used to quickly move to other images in the subfolder. Click anywhere in the cells in the middle to select a particular image in the sequence. Click on the arrows at the end to advance one image in that direction. Drag the highlighted blue cell to other locations to see thumbnails of the intervening images in the subfolder.



Alternatively, the scroll wheel on your mouse will also allow you to move from one image to the next. The right and left arrow keys also will accomplish this.

MAIN IMAGE FOLDER

This folder should be called RAA_Images. Changing the name of this folder will interfere with the proper functioning of the program. This folder should contain only the **image subfolders**.

IMAGE SUBFOLDER

The pictures used in the program are placed in subfolders within the **main image folder**. An individual subfolder is selected, when using the program, to show all the related images in that folder. A subfolder, for example, might contain a series of T1 weighted coronal images of the knee.

There is a set of standard subfolders that are downloaded with the application itself. In the future, there may be “optional” folders of images

that on the website. These **optional subfolders**, if downloaded, would be put in the RAA_Images folder so they would be easily accessed.

OPTIONAL SUBFOLDER (NOT IMPLEMENTED)

There is a set of standard subfolders that are downloaded with the application itself. These are a basic set of axial images of the entire body from the Eycleshymer atlas *A Cross-Section Anatomy* and several other image series. **Optional subfolders** may become available at some later date on the web site but do not exist now. These would be folders of images that could be independently downloaded if the user so chooses. Such folders would be added to the RAA_Images folder.

I have not actually included optional subfolders to date. For now it is easier just to download the entire package. This allows me to fix small errors in any of the images series without having to keep track of everything. Then the user can just re-download everything and get all the little fixes.

This is an idea for the future when the number of image series gets bigger.

DOT DATA FILE

Within each **image subfolder** there will probably be a file called dd_[name of the subfolder]. The file contains the information about the **dots** that lie on the images in that folder. Removing or changing this file will interfere with the proper functioning of the program. This file knows the name of every image in the subfolder and knows how many of such images are present. If the user removes some images or adds some images, this file will be aware that something has changed and will be unable to perform properly.

LABEL CHECKBOX

A checkbox allows the user to request that all the **dots** on the image be attached to text labels at the side of the picture. If there are many dots, this can result in a crowded set of labels. If there are lots and lots of dots, some will not create an attached label. Use at your discretion.

LABEL COLOR SQUARES

If the **label checkbox** is checked, lines are created connecting the dots to the text labels at the sides of the image. Near the **label checkbox** are two colored squares that allow you to specify line colors. Depending on the colors contained in the image itself, various line colors can be more or less conspicuous. Simply clicking on these squares toggles through a default set of colors. You may move backwards through the defaults by Option-clicking. You may select your own custom color by Shift-clicking on the **label color square**.

There are two squares because colors are used alternately when drawing the label lines. This makes the lines easier to follow from the label to the dot when the lines get crowded together. If you want all the lines to be the same color, Shift-Option click on the color that you want.

IMAGE FOLDER SELECTION BUTTON

A button in the right lower corner of the **main window** brings up the **image folder selection window**, which allows the user to select which **image subfolder** to view.

MAIN WINDOW

The program starts up with this window displayed. Here will be displayed the individual anatomic images that the user is reviewing.

IMAGE FOLDER SELECTION WINDOW

Here are listed all the **image subfolders**. The user highlights an entry on this list and then clicks on the view button to bring the images in that subfolder into view. If the Shift key is held down, the thumbnails are not created and the images become visible more quickly.

ANATOMIC INFORMATION WINDOW

Clicking on the text of the highlighted **dot** will bring up this window, which contains information about the anatomic entity.

PURPOSE

Paper anatomy textbooks have some advantages. The best of them have employed skilled medical illustrators to show anatomy in a way that MR or CT cannot, creating images that show relationships between anatomic structures in an abstract and, hopefully, informative way. The text further describes the information.

The problem with these textbooks in the hectic world of the radiologist is that they never seem to be available at the time that you need them. You cannot lug a cartload of these things wherever you go. Each textbook has a different layout that complicates quickly looking up a topic. There are practical limitations on how many pictures they can show. So often, they do

not have a picture that really corresponds to the radiographic image that you are looking at. On the other hand, the RAAViewer is capable of containing a huge selection of images and finding a particular image is easy. Essentially you are scrolling through anatomic images in the same fashion that we scroll through clinical images all day long. Hopefully, over time, the number of images in RAAViewer will increase, and it will provide one source to look at the temporal bone anatomy one day and wrist MR anatomy another.

RAAViewer has become possible because of the speed with which most people are now able to access the Internet to download pictures. MR and CT digital images from a radiology practice and public domain images on the Internet are resources that allow accumulations of useful images and information that can be bundled into a program of this nature and offered gratis to the interested.

TERMINOLOGIA ANATOMICA

International Anatomical Terminology

Frequently, there are many names for the same anatomy. I have made my own choices, sometimes arbitrarily. I have also attempted to provide, in many cases, an “official” name from Terminologia Anatomica.

Ideally, there would be no ambiguity in the naming of anatomic structures. This is an elusive goal for a number of reasons. A major one is the Tower of Babel problem: different nationalities develop their own vocabularies, and there is commonly no simple one-to-one correspondence between terms used by different languages. Also within a given language, there may be a plethora of synonyms for the same structure. Sometimes

different structures are referred to by identical terms due to the confusions and ambiguity inherent in a natural language.

Compounding the situation, human anatomy is itself variable from one individual to the next. A structure may exist in one person that does not exist in the next. Other structures may be combined in different patterns from person to person.

The anatomy of the brain in particular is complicated because morphology and function provide two alternative ways of describing and lumping structures. On-going brain research makes knowledge of the anatomy here more fluid than is true for the rest of the body.

To try attack part of this problem, the Federative Committee on Anatomical Terminology was formed by the International Federation of Associations of Anatomists and charged with coming up with a list of anatomic terms that would be generally agreed upon by the member associations. Their work built upon previous “official” nomenclatures that date back to the Basle Nomina Anatomica (BNA) published in 1895. For historical and political reasons, Latin was chosen as the language in which to create the “official” terms. The hope was that the individual associations would be able to create their own language equivalents that would map one-to-one with the agreed upon Latin terms. The Committee published the English equivalent terms. Every term in the Terminologia Anatomica has its own unique code number.

It is an enormous achievement, not the least of which is related to the fact that it is difficult to coordinate people of different countries and cultures to complete a cooperative endeavor of this type. Terminologia Anatomica was published in 1998 as a book with a list of the code numbers, Latin name and

English equivalent. An accompanying CD contains a primitive program to access the various terms.

It is not perfect for the purposes of the RAAViewer, but I have tried to incorporate it nonetheless. Some of the chosen terms are not the terms generally used in clinical medicine. The list strictly avoids eponyms so a term such as “fallopian tube” is rejected despite the depth with which it is embedded in the medical vocabulary. There are anatomic structures, important in radiology, which do not rate a separate entry in the book.

One annoyance is that many individual terms do not stand on their own. They are presented in the book as a hierarchy of terms. The place in the hierarchy is sometimes required to make sense of the term. An example given in the preface is

A13.3.05.001 Lymph nodes of lower limb

A13.3.05.011 Popliteal nodes

A13.3.05.013 Deep nodes

A13.3.05.013 refers to *Deep popliteal lymph nodes* which you can only know by seeing this particular list entry in context. I would have preferred the entry itself be *Deep popliteal lymph nodes* rather than simply *Deep nodes*.

Synonyms for the selected Latin and English terms are sometimes provided, seemingly most often for the purpose of deprecating the alternative terminology. Sadly, there has not been an attempt to provide any sort of complete list so it is not really a resource to look up the “correct” name for an entity that you might know by another name.

The Terminologia Anatomica has other weaknesses. There might be two separate entries for the same entity. This is generally because there are two places in the hierarchy where it seems appropriate to place this entity. For example, a vein that drains into a different larger vein in different individuals due to anatomic variability might end up having two entries. I doubt that this choice would have been made in a world where computerized databases have become so ubiquitous and triumphant over text in for this purpose. Computers provide alternative ways of dealing with this issue. The most recent version of the Terminologia Anatomica, however, was created at the time this transition was just starting.

If this work had been done a few years later, the basic Terminologia Anatomica list might have been made more computer-friendly and available on the Web. As it is, extracting the terms to use in RAAViewer has been a tedious and wearying process. The program provided on the CD is of very limited help.

The following abbreviations are used:

A. = Artery

Aa. = Arteries

Lig. = Ligament

Ligg. = Ligaments

M. = Muscle

Mm. = Muscles

N. = Nerve

Nn. = Nerves

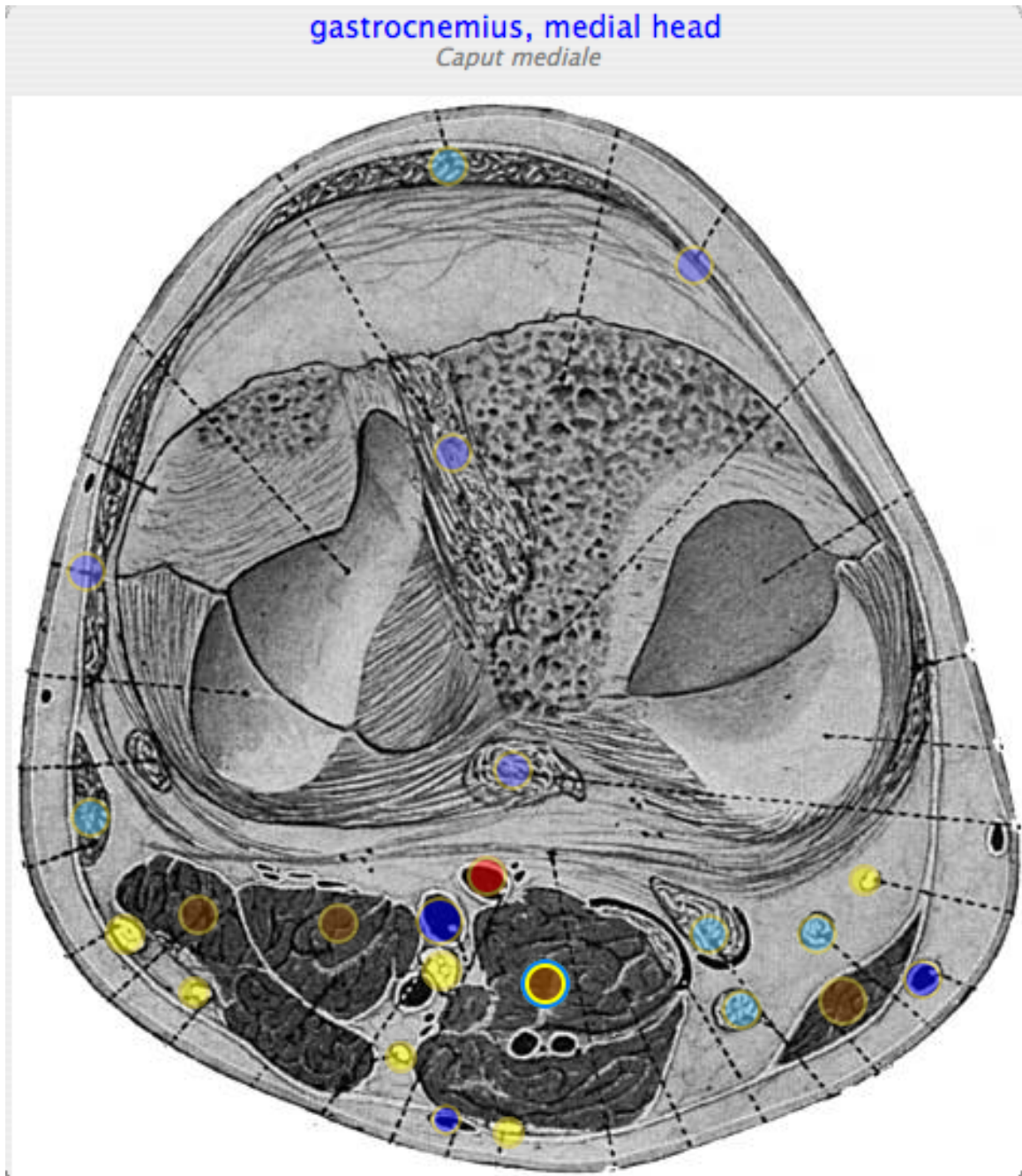
R. = Branch (Ramus)

Rr. = Branches

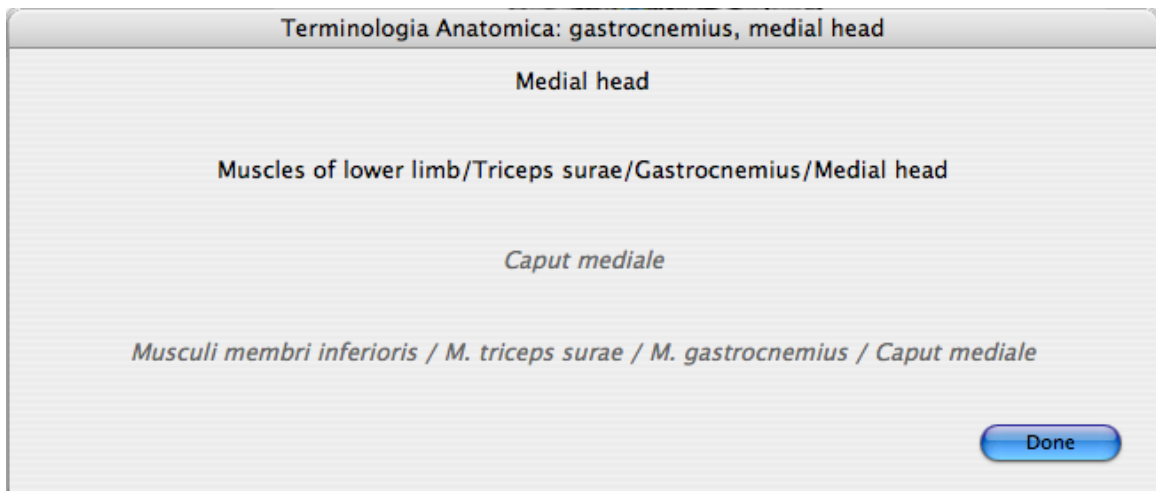
V. = Vein

Vv. = Veins

In RAAViewer, when available, the Terminologia Anatomica Latin term is presented in gray text underneath the English term that I have chosen for the anatomic entity.



If you click on that gray text, a window will pop up that will show the approved Terminologia Anatomica English terms, the synonyms and the terms in hierarchical context.



ALTERNATE LANGUAGES

The program is written in English. I have little facility with any other languages. In Nov 2009, an option was added to allow the user to specify Japanese or Spanish as the language for the anatomic terms. I know no Spanish and less Japanese, but there are sites on the Internet that provide translations of the Terminologia Anatomica terms into those languages.

Japanese: Kazuya Funato Department of Anatomy, Keio University
School of Medicine, Japan

<http://web.sc.itc.keio.ac.jp/anatomy/osteologia/>

Spanish: Apuntes de Anatomia

<http://www.iqb.es/cbasicas/anatomia/clasificacion/indice.htm>

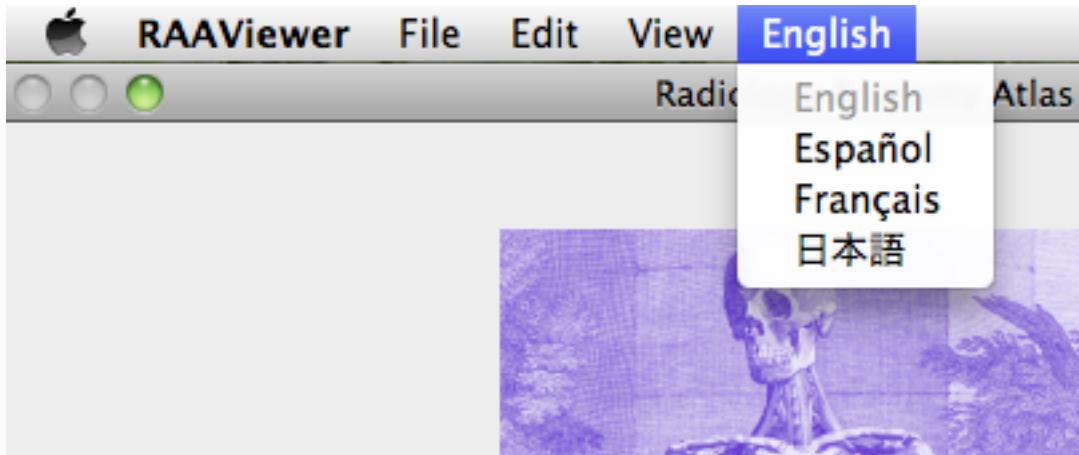
There are a large number of typographical errors in the Spanish listing. Many of these I was able to find and correct because Spanish is close enough to Latin that many terms are recognizable to an English speaker. I have no way of knowing whether there are errors in the Japanese listing.

Using those sources as a starting point, I have incorporated Spanish and Japanese translations for a large subset of the anatomic terms used in this program.

In January 2010, French was added to the supported languages. This was possible due to the assistance of Paul Fabry at the Université de Sherbrooke who has taken an interest in multilingual versions of Terminologia Anatomica.

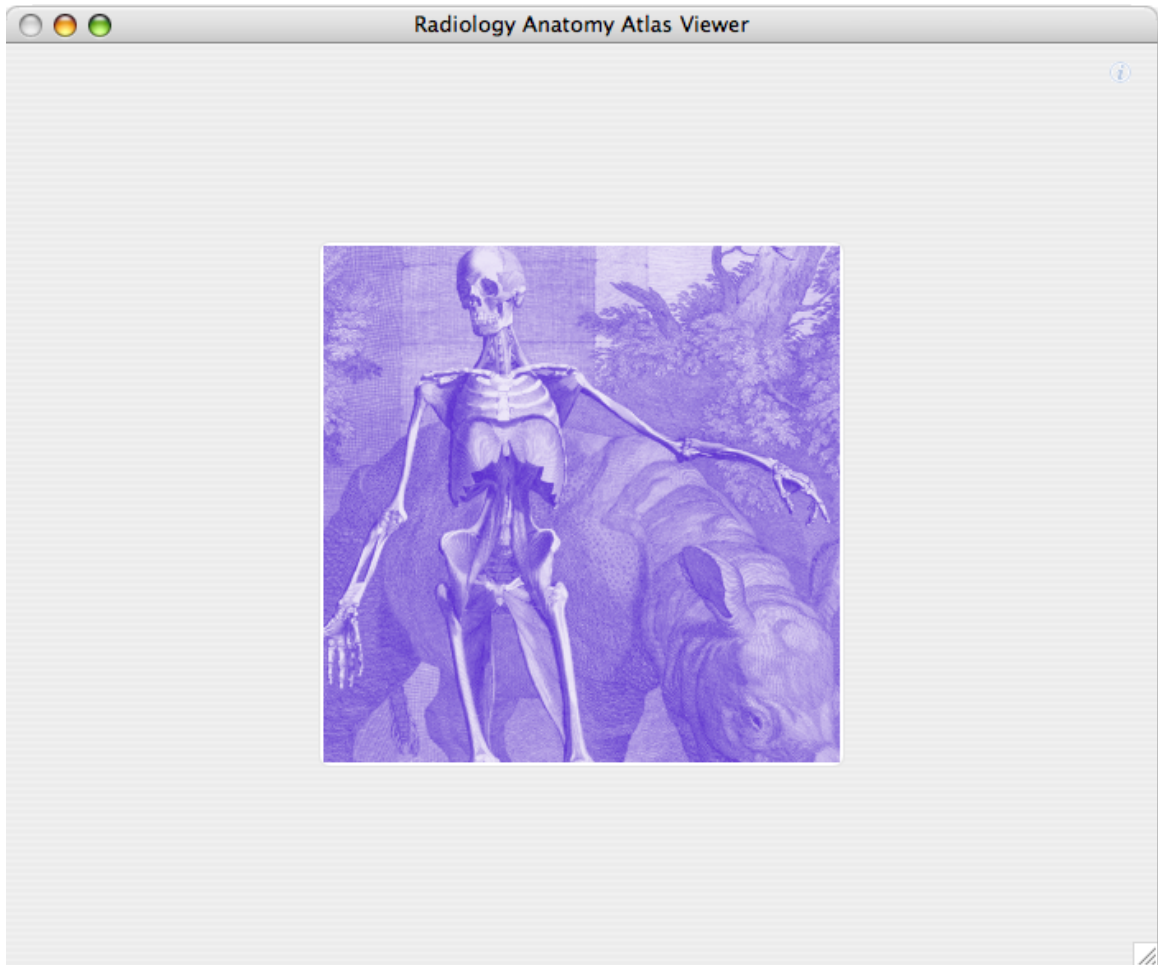
The detailed descriptions and other text remain in English, but if the user selects one of these alternate languages, many of the actual terms will be

displayed in those languages. When the program is launched for the first time, there is a menu that by default will display **English**. That menu can be used to specify one of the other languages.

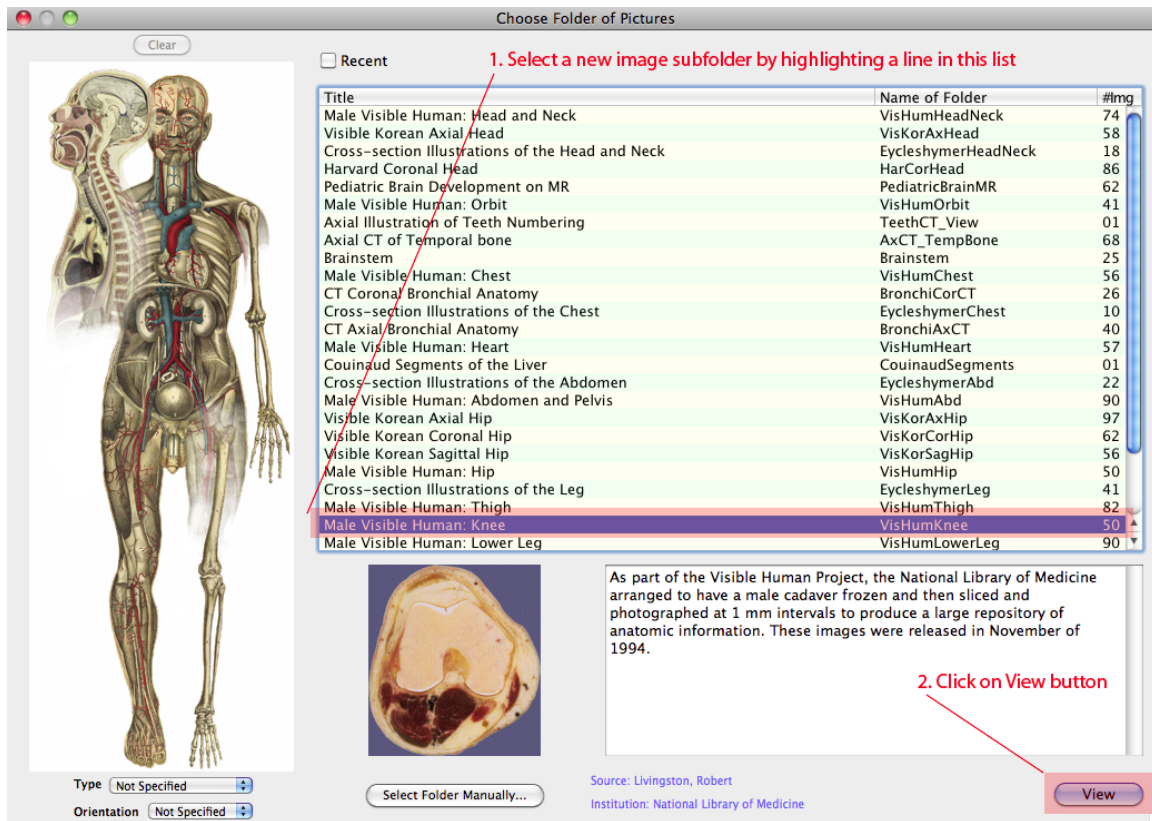


INSTRUCTIONS

Main window (Initial Appearance)



On initially opening the program, the window above appears. Go to the **File** menu and choose **Open Images Series...** This opens up a new window, the **image folder selection window**. A useful shortcut is just to click on the snout of the rhinoceros. For the really impatient, launching the program with the Alt key held down brings you immediately to the **image folder selection window**.



In the **image folder selection window**, a list of the **image subfolders** will appear. A specific folder of images is selected by clicking on it. Then click on the **View** button to see the images that you have selected. The list contains all the possible folders that are known to RAAViewer. If a particular folder is not in the RAA_Images folder, it will be grayed out and not selectable.

In the lower mid-portion of the window, there is a **Select Folder Manually** button. This will open up the standard dialog boxes to find a folder anywhere on your hard drive. Because **optional images subfolders** are not available at this time, **Select Folder Manually...** is of little use. Its functionality will be developed in the future. If you have downloaded a new **optional images subfolder**, but have not recently download the program

itself, it is possible that this optional folder will not appear in the listing on the **image folder selection window**. This button will allow you to access this new folder of images until such time as you can download the latest version of the program.

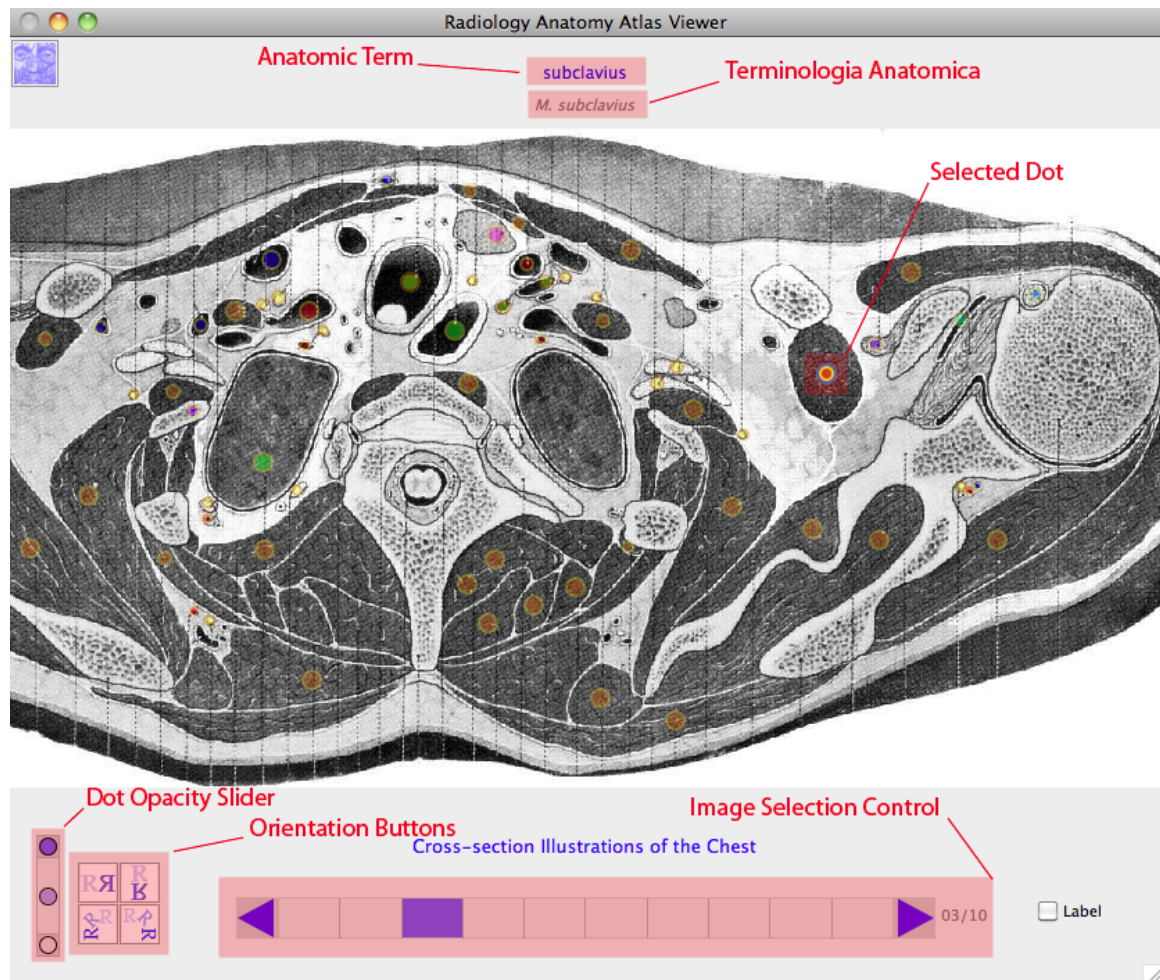
On the left side of the window, there are tools to *prioritize* the **image subfolders**. These do not filter out folders; rather they sort the listing so that those best meeting the criteria appear toward the top of the list. The picture of the standing human on the left can serve to sort the folders of interest by anatomic region. Click on the part of the body that you are interested in (for example the knee) and the list will re-sort itself such that the **image subfolders** that relate to the knee will float to the top. A red line will appear on the diagram to indicate where it was clicked. It is also possible to click and drag to indicate a region of interest on the human diagram. In this situation, two red lines will appear indicating the boundary of the selected region. There is a **Clear** button at the top of the picture to clear away the red lines.

Underneath the picture are two pop-ups that can also be used to prioritize the list, for example to look for coronal scans. Again, the list will re-sort itself to place the requested type of images at the top.

The ability to smart sort the list of image folders will become more useful as the list of such subfolders gets longer.

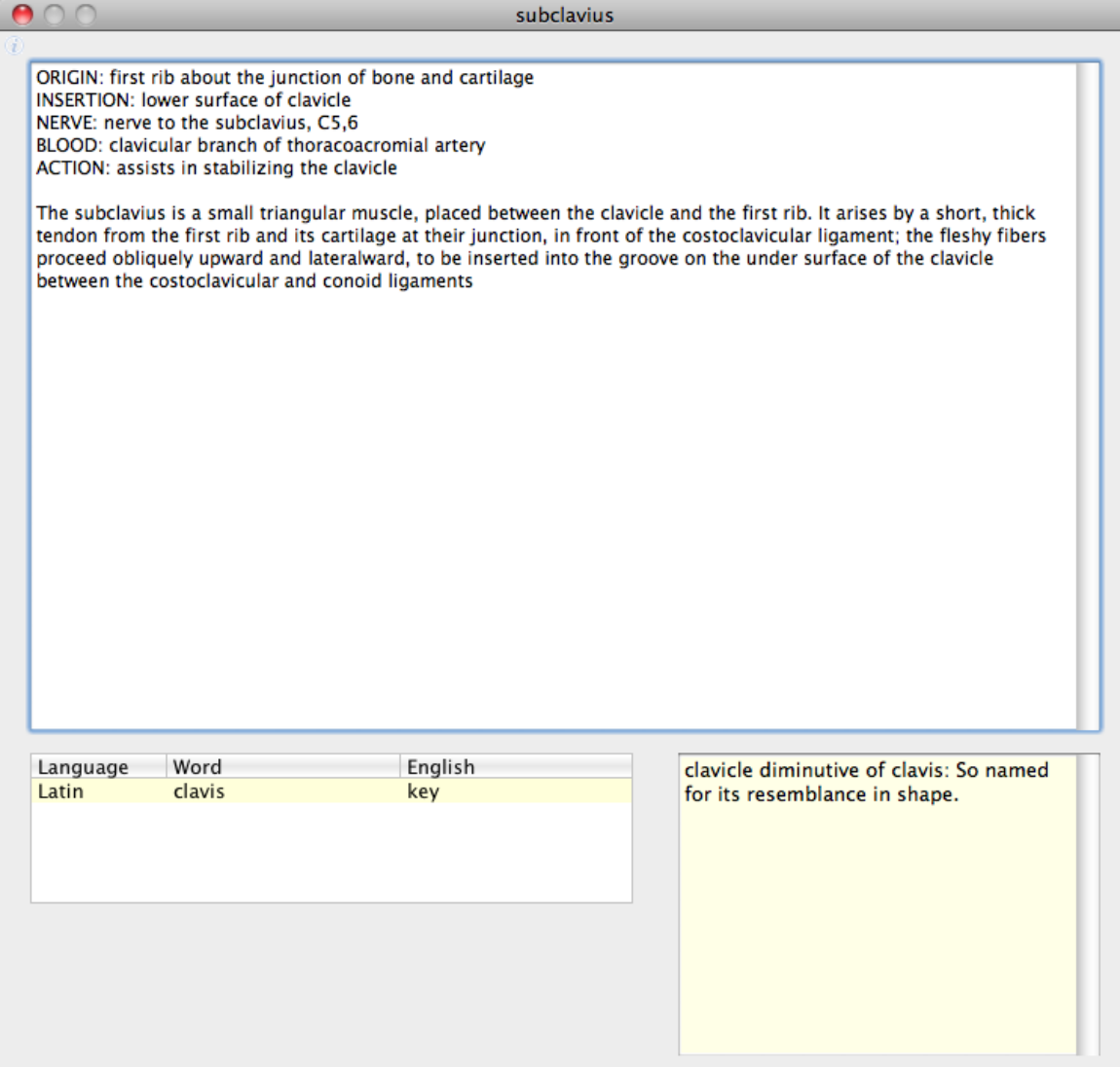
On the top of the window, there are checkboxes that *filter* the list. The **Recent** checkbox will restrict the list to image folders that have been examined recently.

Main window (Showing Specific Picture)



The various controls for this window are labeled in the above picture. Use the **image selection control** to navigate from one picture to the next in the selected **image subfolder**. The **orientation buttons** will flip the image around which can be useful to match the atlas image with the radiographic image that you are interested in. For example, an image of the right arm can be converted into an image of the left.

Clicking on a **dot** will select it. The corresponding anatomic term (in the example above – subclavius) will appear above the picture. The selected **dot** is highlighted as can be seen in the illustration above in the right upper corner. When the word is written in blue, as it here, then clicking on that word will bring up the **anatomic information window** that be seen below.



subclavius

ORIGIN: first rib about the junction of bone and cartilage
INSERTION: lower surface of clavicle
NERVE: nerve to the subclavius, C5,6
BLOOD: clavicular branch of thoracoacromial artery
ACTION: assists in stabilizing the clavicle

The subclavius is a small triangular muscle, placed between the clavicle and the first rib. It arises by a short, thick tendon from the first rib and its cartilage at their junction, in front of the costoclavicular ligament; the fleshy fibers proceed obliquely upward and lateralward, to be inserted into the groove on the under surface of the clavicle between the costoclavicular and conoid ligaments

Language	Word	English
Latin	clavis	key

clavicle diminutive of clavis: So named for its resemblance in shape.

The **anatomic information window** contains data about the anatomic entity that has been selected. In some cases, as seen here, there is additional information lower down in the window about the etymologic derivation of the word. When those lines are highlighted in yellow (as the first one can be

seen in the example above) then it is possible to click on the line in question to see yet more information about that line. When applicable, lists of individuals connected historically with the entity, will appear.

When done with looking at the **anatomic information window**, click on the close button at the top of the window to make it disappear.



Click on this button (or go to the **File** menu and choose **Open Images Series...**) to return to **image folder selection window**.

These instructions should be enough to get you started with using this program, which is simple in design.

DATA SOURCES

I am not an anatomist and have done no original research in this field. The information in the **anatomic information window** comes from secondary sources. The most heavily used sources are:

1. Gray's Anatomy (1918) This anatomy textbook is outdated but has the advantage of being out of copyright.

<http://www.bartleby.com/107/>

2. Wikipedia. This web site is an information resource created by the public. Most of the anatomic information in this encyclopedia is derived from the Gray's Anatomy source mentioned above, but it can still be very useful.

http://en.wikipedia.org/wiki/Main_Page

3. Who named it – is a delightful website that has posted small biographies of many of the men (and the very rare women) whose names are remembered in eponyms. The whole topic of eponyms is a contentious one, but the biographies of those so honored are interesting even if the selection of such individuals is capricious.

<http://www.whonamedit.com/>

4. BrainInfo (NeuroNames) Unfortunately, I became aware of this resource relatively late in the project. The project is an effort to come up with a rational, consistent and hierarchical lexicon for neuroanatomic terms. This was developed in the modern computer era and escapes some of the problems embedded in Terminologia

Anatomica. The problems of redundancy and ambiguity and overlap are severest in the area of brain anatomy, and this resource presents one approach to the problem.

<http://braininfo.rprc.washington.edu/Default.aspx>

Final Comments

This manual covers the highlights, but to learn the program you have to use it. It is not very difficult.

For updates of the program, go to

<http://www.rrlivingston.com/RAAViewer>

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