Bone Ninja   -   INTRODUCTORY USER GUIDE

Introduction

Bone Ninja is designed to help surgeons learn how to analyze long bone deformities.

Several sub-specialties within orthopedic surgery deal with the correction of crooked

bones that result from birth defects, developmental problems, or malunited fractures. To

correct the deformity, one must first characterize the deformity and then appropriately

plan a corrective strategy.

In the past, surgeons have been taught bone deformity correction with traditional tools

(e.g., paper, pencil, protractor, ruler, goniometer). These tools worked well with hard

copy x-rays. In the current digital era, the majority of radiographs are now images on a

computer screen. Pencils and goniometers do not translate well to the new digital medium.

Surgeons must now use digital tools to measure deformities and plan correction. Standard

Picture Archiving and Communication System (PACS) tools are not generally designed

for deformity planning.

The evolution of this new format is important as we teach the new generation of surgeons

who are particularly adept with digital tools. If you were born in 1982 or later (Gen Y),

then you will probably succeed quickly with Bone Ninja. If you were born between 1966

and 1981 (Gen X), then you may need a little more time to understand the Bone Ninja

tools. If you were born before 1965 (baby boomer) then you may need to really try hard

to "get it." (These dates are subject to debate, and so you should feel free to move

yourself up or down a generation depending on how you digitally adept you are…) Bone Ninja's teaching metaphors are based on the types of line/angle tools commonly found on hospital and office-based PACS machines, supplemented with additional sophisticated "paper doll" cutting tools that are available in sophisticated planning programs. It is said that the best Apps require no manual or instruction. Perhaps that is true, but the more complex a computer program, the more time one needs to spend to learn how to use it. For example, you can spend $250 on Adobe Illustrator for your computer, but unless you invest the time to learn how to use it, it will not be worth the money you paid. Likewise, with Bone Ninja, you must invest a certain amount of time becoming facile with the program to perceive the benefit.

Bone Ninja is not a clinical tool, but rather an educational tool. We feel this case-based approach will assist clinicians in learning bone deformity analysis and correction. The foundation of deformity analysis may be found in the textbook *Principles of Deformity Correction* (Springer 2002) by Dror Paley with editorial assistance from John E. Herzenberg. Based on this classic work, Bone Ninja helps to push the envelope further with new planning approaches, embracing the new digital technology available on the mobile iOS iPad platform.

The primary authors of this app (Dr. Shawn Standard and Dr. John Herzenberg) have a combined experience of more than 40 years working in the fields of deformity analysis and corrective surgery. This experience includes teaching an annual seminar, the

Baltimore Limb Deformity Course (BLDC), now in its 22nd year. We developed this app to supplement the BLDC and look forward to feedback from attendees and other users.

This app will be periodically updated by adding more case examples, more explanations, and more tools. The moniker "Bone Ninja" is intentionally whimsical and reflects our philosophy of teaching as "infotainment." Enjoy!

Disclaimer

The Bone Ninja App is designed for educational purposes only. The intent is to train physicians how to analyze long bone deformities. The Bone Ninja App is not intended to be used for medical diagnosis or treatment. In view of the possibility of human error or changes in medical science, neither the authors nor the developer warrant that the information contained in this software is accurate or complete, and they are not responsible for any errors or omissions or the results obtained from the use of such information.

About Bone Ninja

Bone Ninja comes preloaded with case examples. Each case example is accompanied by a recommended solution so that the student can receive feedback. For additional information and help using this app, please visit www.LimbLength.org. We will post video tutorials on YouTube for your benefit.

Downloading Bone Ninja

After you purchase Bone Ninja, it will download with the first 10 case examples. The

remaining 22 cases can be downloaded when you launch Bone Ninja, provided you are

connected to a WiFi network. Push the "Download Current Cases & Resources" button

on the top menu bar on the main menu page. This will automatically synchronize your

iPad to our most current collection of case studies. We plan to revise and add cases on a

regular basis, and by pressing this button periodically, your Bone Ninja will stay current.

Please note that this is a synchronization process, not an upgrade process. During

synchronization, there is no need to type in your Apple ID or password. In the future,

there will be updates to the functionality of the App itself, which will require you to

upgrade in the usual iTunes App Store way, with your Apple ID and password.

Notifications for version upgrades will come in the usual iTunes way. Bone Ninja is

available exclusively on the Apple iPad and no other platform.

Loading a Supplied Case

Load cases from the Main Menu page by tapping anywhere on the case in the large

thumbnail or by tapping on the "Start Case" button in the small thumbnail view. The

cases are grouped by type: normal alignment, assessment of limb alignment, tibia single

level deformity, tibia double level deformity, tibia sagittal plane deformity, tibia oblique

plane deformity, femur single level deformity, femur double level deformity, femur

sagittal plane deformity, and femur oblique plane deformity. Click on the case you wish

to try, and it will automatically load into the program.

Case View Options in Main Menu

In the main menu page, the cases may be displayed in either list form with tiny thumbnails or in a more graphic format with larger thumbnails. Choose which format you prefer by toggling back and forth on the two buttons on the far right side of the top menu bar in the Main Menu page.

Loading Your Own Examples

You may upload your own case examples into Bone Ninja two ways: e-mail yourself a file containing a jpeg of the radiograph or take a photo with your iPod camera from your PACS computer screen/hard copy film. Most PACS systems allow you to save an image and then e-mail it. If you e-mail yourself a photo of an image, then download that photo into your "Photo Library" on your iPad. If you use the iPad camera to photograph it, the image will appear in your "Camera Roll." The new iPad ("iPad 3") has a five megapixel camera that creates clear and detailed images of radiographs. The older versions of the iPad have only a one megapixel camera. For this reason, using the camera option to upload to Bone Ninja works better on the new iPad.

When you are in the Main Menu of Bone Ninja, press on the upper left hand button entitled "Add Photo." A drop down menu will appear, and you can find your image in either the "Photo Library" or "Camera Roll" in your iPad. Once you start saving cases that you have worked on, they will also appear in this drop down menu, under the category "Bone Ninja Photo Album."

Saving Your Work

When you have completed an analysis and wish to save it, push the "Save" button on the upper right hand menu bar. This will make a pop up menu appear that gives you the option of saving the image in the "Bone Ninja Photo Album" or sending it via e-mail. When you press the "send via e-mail" option, your e-mail program will appear and you can designate the addressee and type in any additional message. When you save the image or send it via e-mail, you can later view these images but you cannot modify the elements (lines, cut outs) within the Bone Ninja app. You can, however, make new lines and new cut-outs on saved images.

Bone Ninja's Main Working Page

The main working page contains the tools and displays the case. The top menu bar of this page includes nine buttons: "Menu", "Reset", "Calibrate", "Resources", "Compare", "Undo step", "Redo step", "Save", and "Settings". Undo step, Redo step, and Settings are denoted by icons, not words.

"Menu": Press this button to return to the main menu of cases. Caution! If you press this button, you will lose any work that you made on your current case, unless you saved it.

"Reset": Press this to clear all your work (arrows, cut-outs, angles) and get back to the clean, original x-ray image of that case. Caution! If you hit reset, you will lose any work you made on your current case, unless you saved it.

"Calibrate": After loading a case from the menu or loading an imported case, you should calibrate the magnification marker. Our pre-loaded cases contain a one inch (2.54 cm) magnification ball, and the calibration window that appears just below the top menu bar is set to default to 2.54 cm (one inch). You can change this by tapping on the calibration

value window, and typing in any value you wish for your particular calibration marker. Grab the baby blue calibration circle by the dotted circumferential line and drag it over the calibration ball or object. Then resize it with the two solid baby blue balls on either side to fit the magnification marker. Don't forget to hit the "Save" button on the calibration menu bar to record your calibration value!

"Resources": Press this button at any time to bring up a menu of additional resources that include standard measurements and foot measurements. This is useful if you forget what the normal values are for LDFA, MPTA, etc. Tap anywhere outside the Resources box to get back to your case.

"Compare": Tap this button to see a solution, or in some cases, more than one solution for the case you are working on. This only works for cases that are pre-loaded, not your own cases. We urge you to try to solve the cases on your own before looking at the solutions. When you are in the "Compare" screen, you will see your version of the case next to the provided solution. In some cases, there is more than one solution. The other solutions are viewed by toggling the forward and back buttons next to "Solution Versions." Pushing the "Return to Case" button on the top left of the "Solutions" page takes you back to your case, and you may resume working on it.

"Un-do": Pushing this button will take you back a step.

"Re-do": Pushing this button will take you forward a step.

"Save": Pushing this button launches the Save Menu to allow you to save your case as a jpeg or to e-mail it. See section above on *Saving your work…*

"Settings": Push this (gear) button to launch the "Settings" window. "Auto angles" can be turned on or off. When on, it will show the angle created by two crossing lines. "Move

arrows" (nudge tool) can be turned on or off. If on, then four small arrow buttons will appear in the lower left screen. These pressed, the arrows will slowly "nudge" any selected element up, down, to the right, or to the left. This is used to gently and accurately move an object such as a line or a cut-out segment. When changing a setting button, you must also push the "Done" button to confirm your change.

Toolbar

The main toolbar is briefly described on pages 3, 4, and 5 of the "Instructions" overview in the "Settings" menu (gear button). With the tool bar, you need to select the tool you would like to use, by pushing that button, which becomes highlighted. For example, choose the line tool and draw a colored line. By holding the line tool button down for a few seconds, the color palate emerges and you can select the line color. Use the line tool to draw a line. If you wish to go back to that line and modify it (move it, angle it, shorten it), you must go back to the toolbar and choose the "Select/Move tool." If you then wish to draw a second line, you must go back and choose the "Draw Lines" tool, and so forth. You can make lines in seven different colors. However, when an object is selected, including a line, it temporarily becomes baby blue (Robin's egg blue, Carolina blue). It will revert to its native color when you click somewhere else on the screen (this action un-selects it). If you wish to group two objects, such as a line and a cut-out section, then you can keep touching different objects and they will all turn baby blue and be linked. Selecting a line will cause a menu bar to appear with the length of that line in centimeters and will allow you to "Lock" that line so that it may not be moved again. If you change your mind and wish to move that locked line, simply select the line (it turns baby blue)

and then hit the "Unlock" button. There is also a "Delete" button if you want to see that line disappear forever.

To measure a distance, hit the "Ruler" tool and then draw a line. Alternatively, draw a line with the "Draw Lines" tool, and then select the line to see its length displayed above.

The "cut-out" tool button will allow you to encircle an object with dots, and when you close the circle, that area inside the dots will be treated as an object that can be selected, moved, and rotated. It can also be grouped with lines. This "cut-out" tool is used to simulate osteotomies. After selecting a cut-out area, you can then use the Thumb Tack tool (from the pull across menu of the "Select/Move Tools" button) to enforce a rotational movement of the cut-out area around a specific point. The default position of the Thumb Tack is the geometric center of the cut-out piece, but you can drag the Thumb Tack to the level of the Apex of the deformity, for example.

The "Annotations" button allows you to make notes on the image. These notes can later be selected with the select tool (turning baby blue) and then moved, rotated, locked, or deleted.

The toolbar can be slid back away from view by pressing the orange tab at the bottom of the bar.

MAP Menu

The right hand side of the screen has a chart with values that you can fill in as you proceed with your initial analysis. You may fill out all or part of the MAP chart, according to your needs. For beginners, it is recommended to conscientiously fill out the

entire chart. Experts may wish to only note the critical numbers (LDFA, MPTA). The order of the chart reflects the mnemonic "MAP" that we recommend. **M** – **M**easure the MAD/Lift; **A** – **A**nalyze the joint angles/bone lengths; and **P** – **P**ick the bone to treat. Once the initial measuring and analysis is complete, you can then proceed to perform the "ABC's"....**A** – determine **A**pex of deformity; **B** – choose a **B**one cut level; and **C** – choose a correction level and type. The MAP chart can be moved off of the screen by pressing on the orange pull tab on the bottom of the MAP chart.

Definition of Acronyms found in the MAP menu and the App

ABC: **A**pex; **B**one cut; **C**orrection

ADTA: anterior distal tibial angle

aLDFA: anatomic lateral distal femoral angle

aMPFA: anatomic medial proximal femoral angle

JLCA: joint line convergence angle

L: left

LDFA: lateral distal femoral angle

LDTA: lateral distal tibial angle

LLD: limb length discrepancy

MAD: mechanical axis deviation

MAP: **M**easure MAD & Shoe Lift; **A**nalyze joint angles; **P**ick the bone

mLDFA: mechanical lateral distal femoral angle

mLPFA: mechanical lateral proximal femoral angle

MPTA: medial proximal tibial angle

PDFA: posterior distal femoral angle

PPTA: posterior proximal tibial angle

R: right

References

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Credits

Bone Ninja

Version 1.0

Authors:

Shawn C. Standard, MD

John E. Herzenberg, MD, FRCSC

International Center for Limb Lengthening

Rubin Institute for Advanced Orthopedics

Sinai Hospital of Baltimore

2401 West Belvedere Avenue

Baltimore, Maryland, USA 21215

www.LimbLength.org

www.DeformityCourse.com

Programming:

No Inc.

www.noinc.com

Project Manager:

Madeline Bacon

Artwork:

Joy Marlowe, MA

Jonathan Bush

Editing:

Amanda Chase, MA

Support/Contact Us

We welcome your feedback and comments, as we are committed to improving Bone

Ninja to suit your needs. If you have any questions or experience any problems, please e-

mail us at icll@lifebridgehealth.org.