Medical illustration using an iPad and the Procreate app

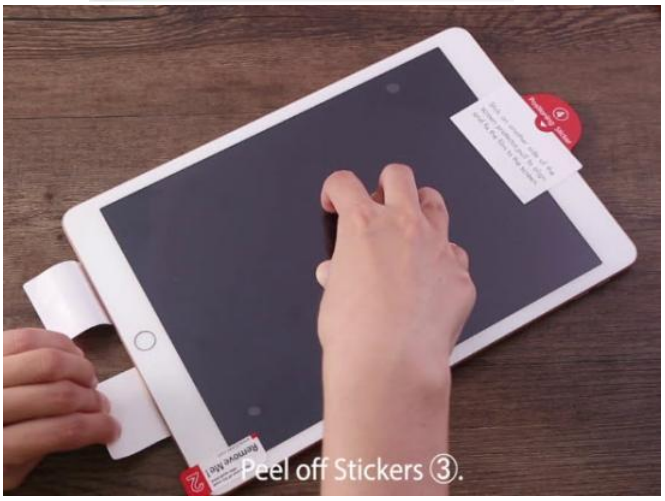
David W. Low, MD **March 2025**
Professor of Surgery
Division of Plastic, Reconstructive, and Oral Surgery
Perelman School of Medicine at the University of Pennsylvania
The Children's Hospital of Philadelphia
low@chop.edu

Attached are some basic instructions to help you master Procreate. I will cover as many of these techniques as time allows during the workshop, so you don't have to know them ahead of time. They will also come in handy if you forget some of the details. I learned to use Procreate mostly by trial and error, and I still have not learned all the features of this versatile app. Hopefully this guide will speed up your learning curve, and with time and experience you will discover your own way to incorporate it into your practice. Not only can it help you document your practice and educate your patients, you can also easily touch up your personal photographs and make your own personalized greeting cards.

I have also included some helpful illustrations and photos which you are free to use:

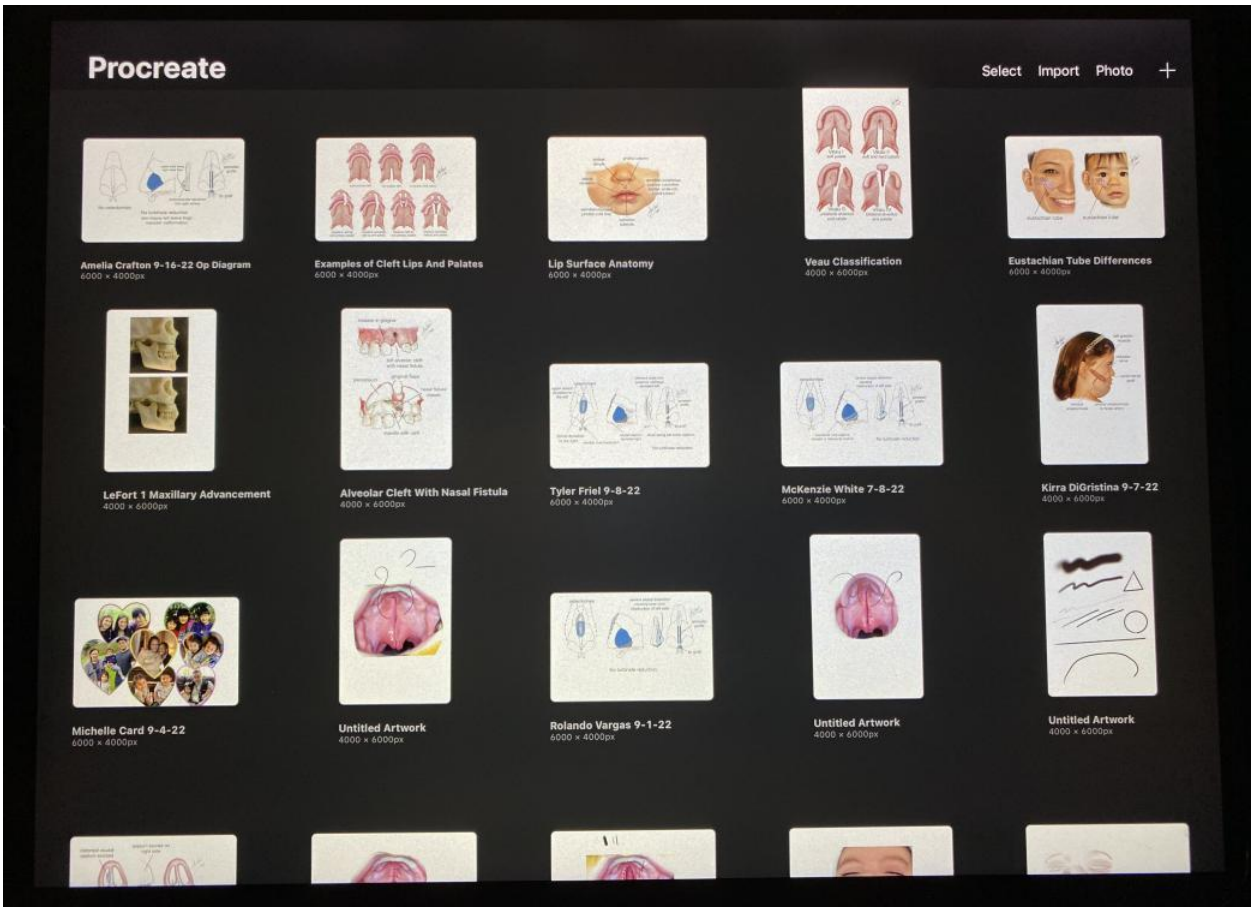
a. **Line drawing of normal lip and palate, various cleft patterns**
b. **Photos of cleft lips and palates**
c. **Common instruments in cleft surgery**
d. **Sagittal view of the nose, palate, oral airway, and nasopharynx**
e. **LAHSHAL (Kriens) classification of clefts**
f. **Exercises which we will use during the workshop. You can also practice these exercises at your leisure to increase your familiarity and skill with this app.**

1. Procreate – download the app onto your iPad (about $10 US, available in 13 languages)
2. Optional but useful accessories:
   a. screen protector available via Amazon.com called "Icarez" - This will simulate drawing on paper in addition to protecting your glass screen.

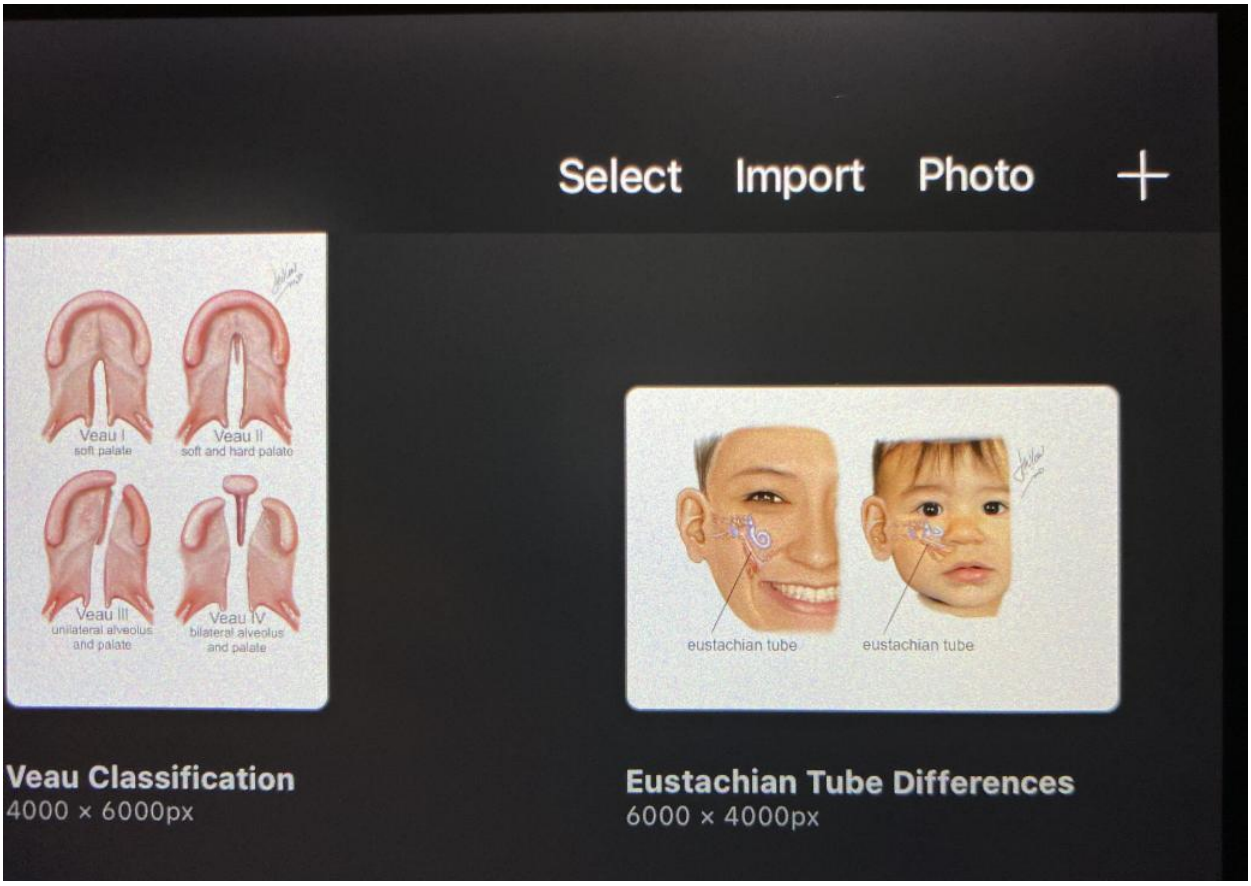


b. digital drawing glove – this will reduce unintended marks on your drawing by keeping your hand from touching the screen while leaving your thumb, index and long fingers free for maneuvers that require fingertip contact with the screen. You can also make your own by amputating part of a lightweight cloth glove.

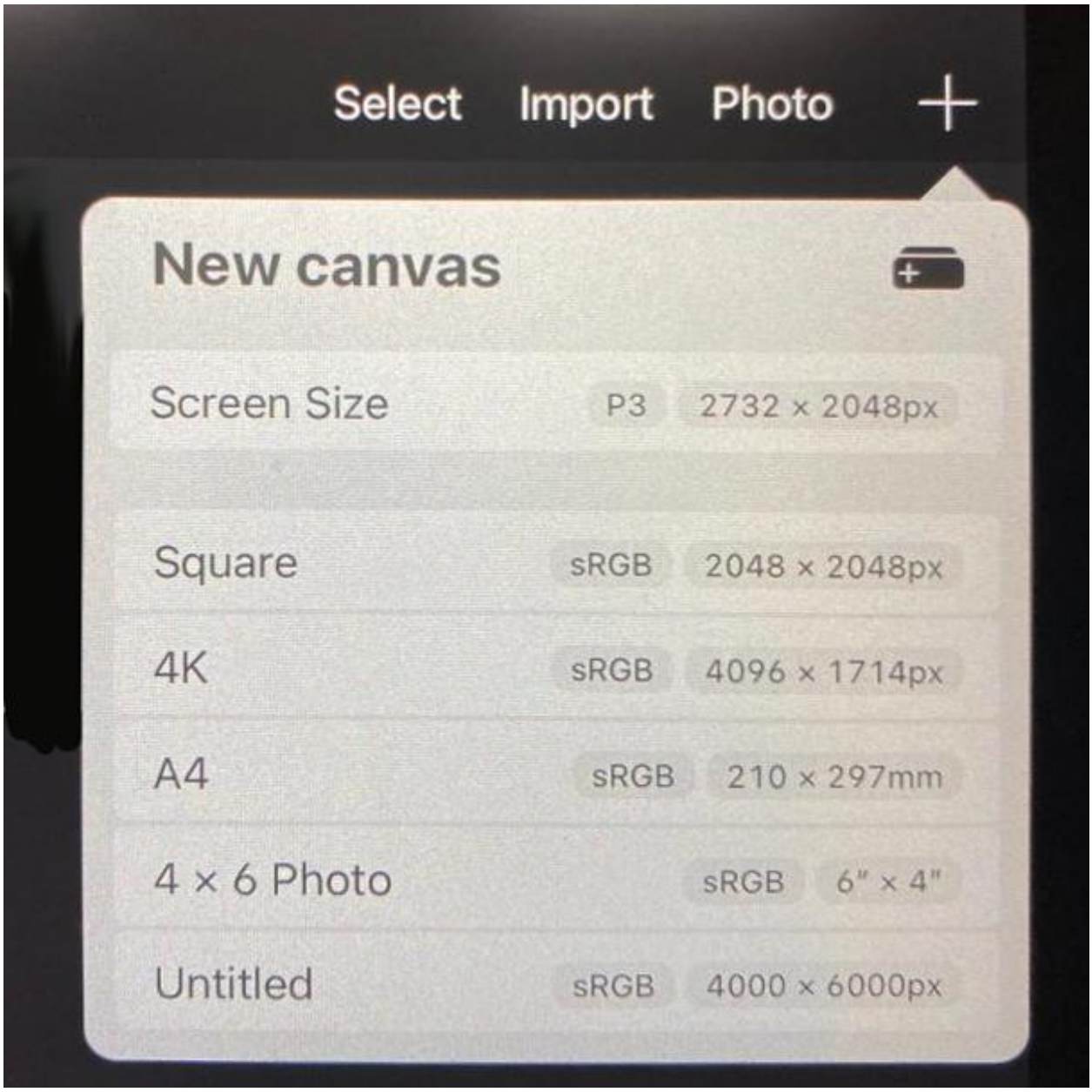
3. When you first open Procreate, you will see any previous illustrations and a few tools at the upper right hand corner:



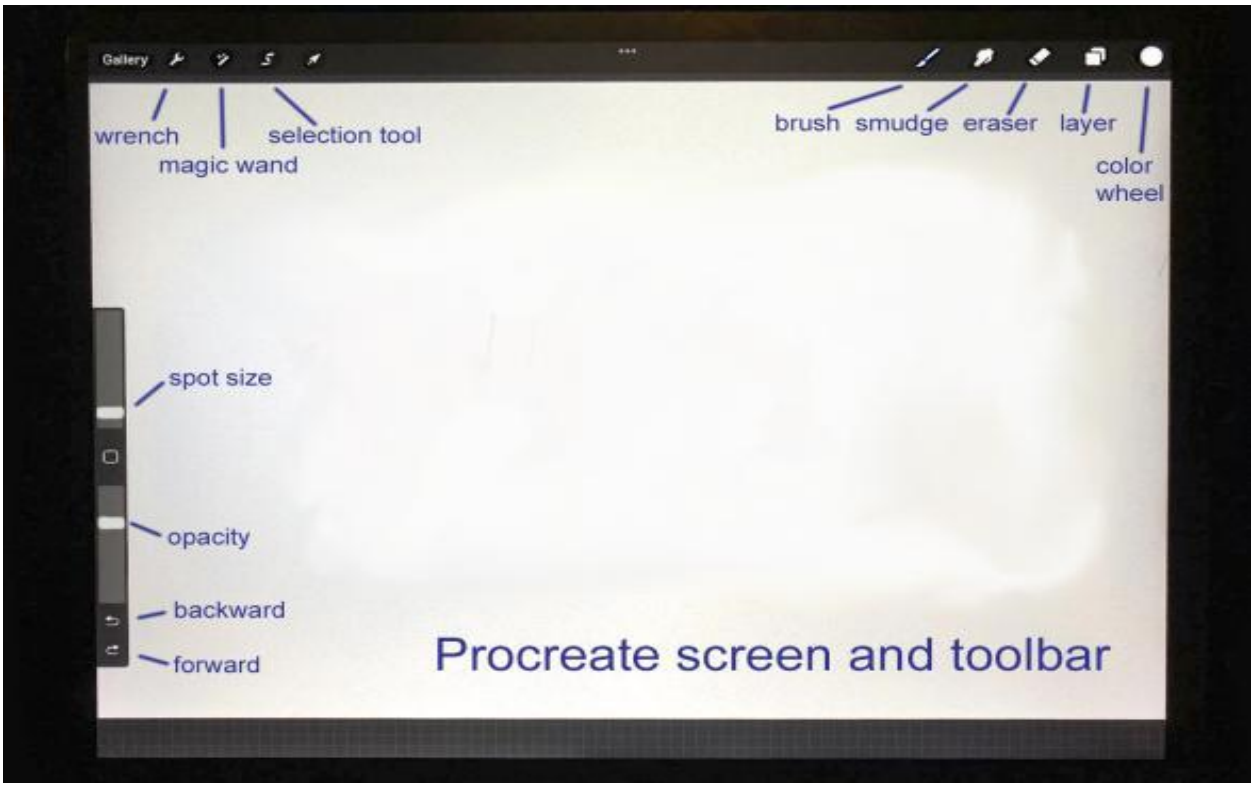
4. Selecting a canvas/ making a new canvas (these are blank white screens on which you will draw)
   a. Click on the “+” sign
   b. A series of canvas sizes will appear, or you can make your own



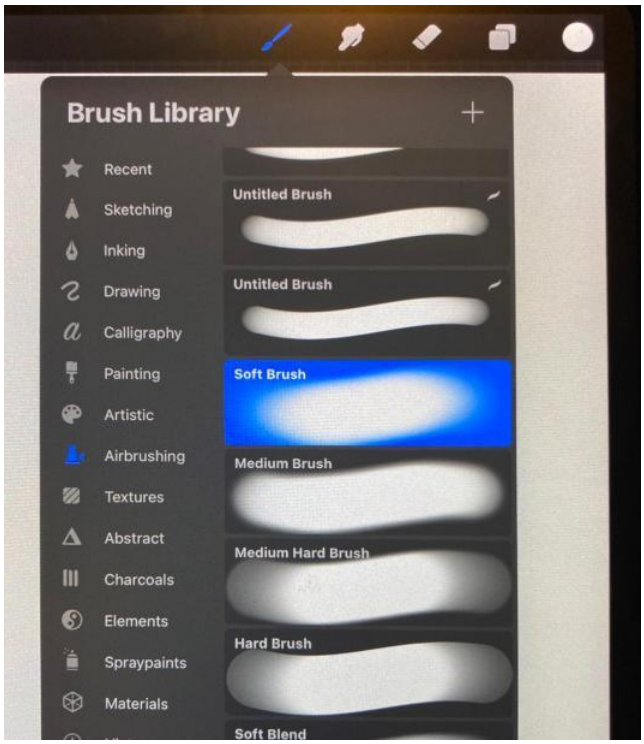
d. Choose a canvas size or create your own
e. To make your own, click on the "+" black box next to New canvas
f. Type in the Width and Height, such as 4000px and 6000px, and click "create"
g. The new canvas will appear in the list of available canvases. I personally use either "screen size" (on my ipad, 2732 x 2048), or a custom "untitled" canvas (4000 x 6000)
h. Just as with a smart phone, you can zoom out or zoom in using two fingers to pinch or expand the field of view

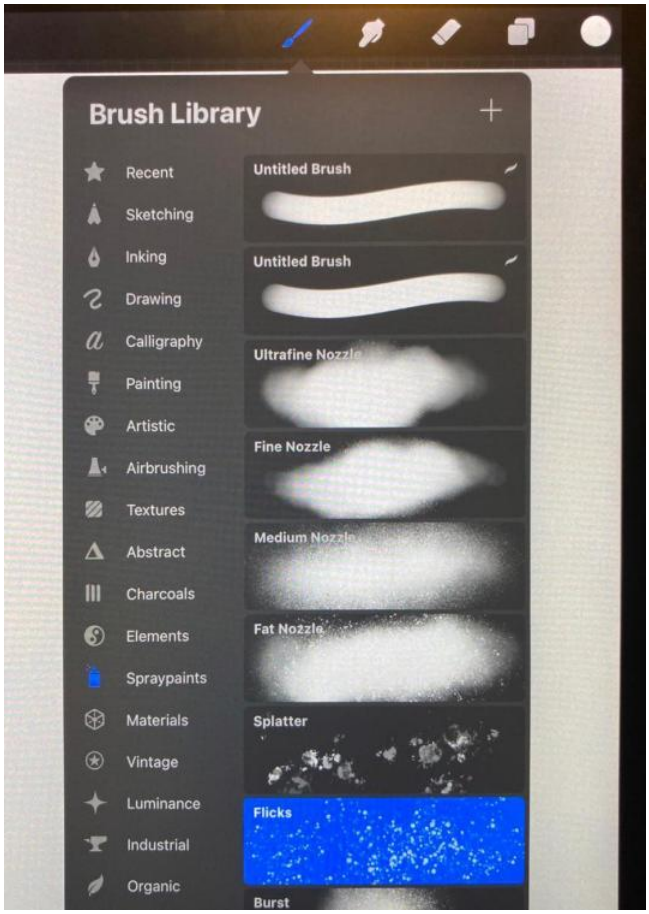


5. The basic Procreate screen has a very manageable number of tools



6. Brush library – there are hundreds, but I predominantly use only 3
   a. Airbrushing – soft brush, for 95% of my illustrations
   b. Airbrushing – hard brush, for sutures, needles, and leader lines for labels
   c. Spraypaints – Flicks (gives a stippled appearance), for texture

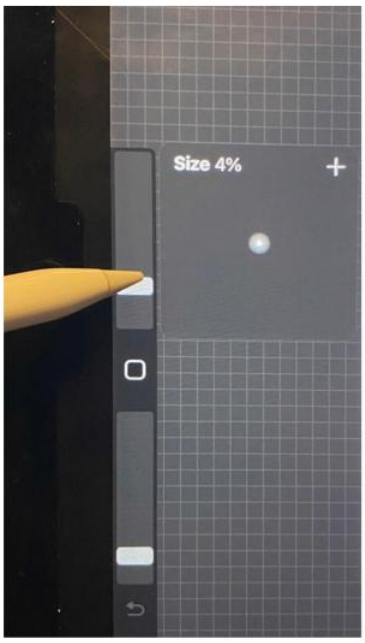




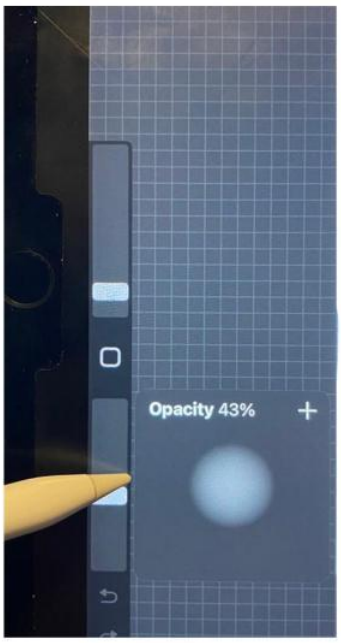
7. Brush size and opacity adjustments

a. Use your iPencil or finger to adjust the sliding bars on the left side to change size and opacity

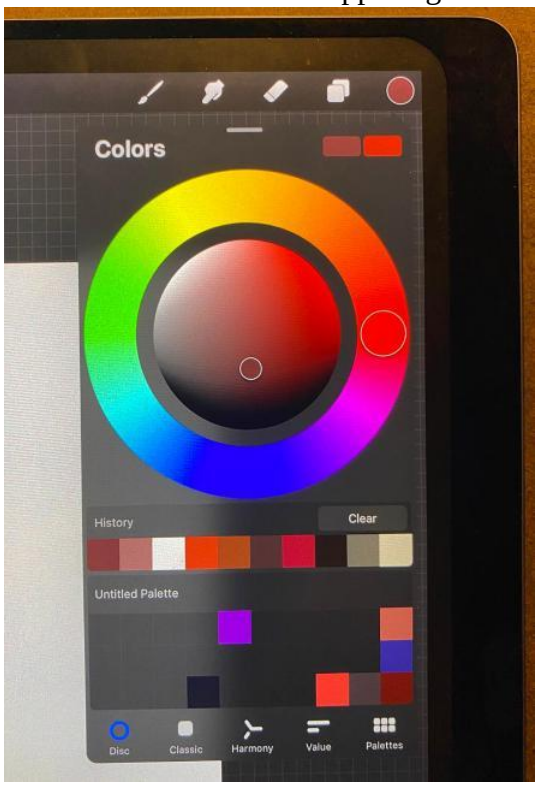
size



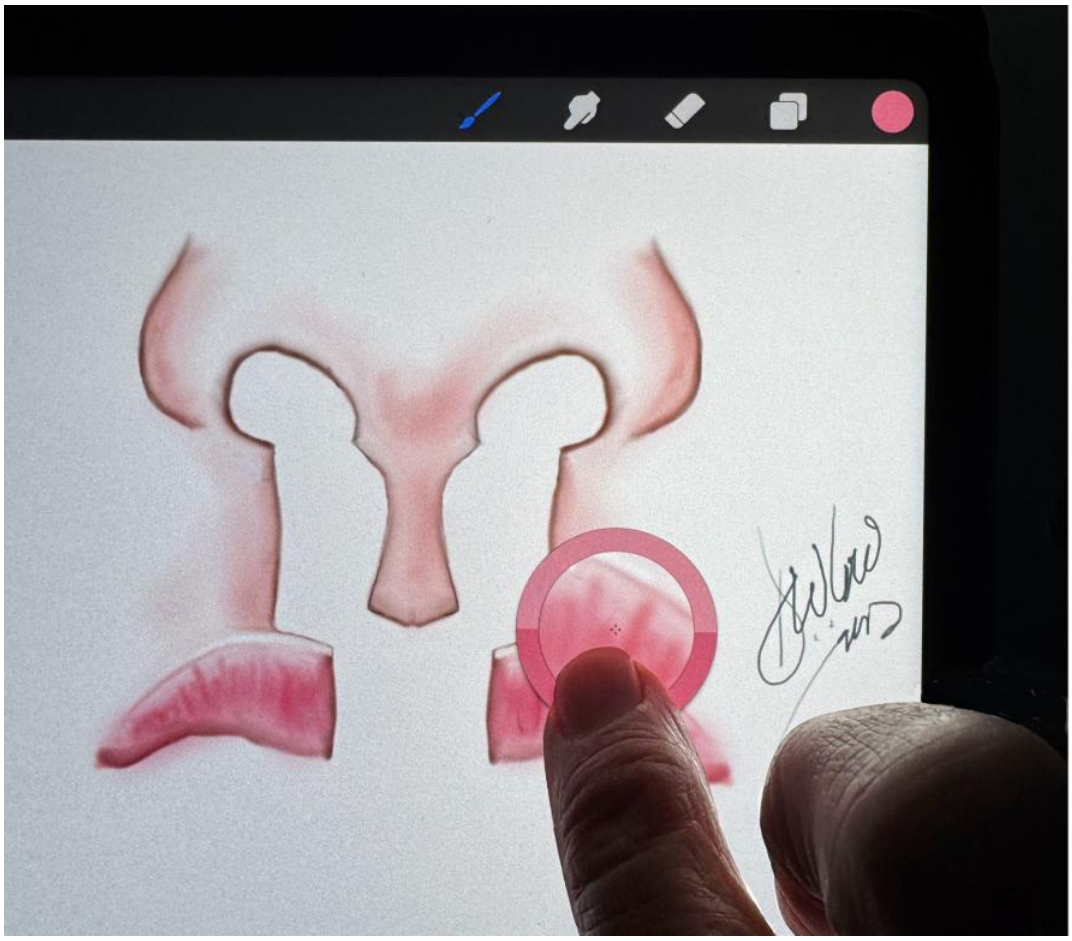
opacity



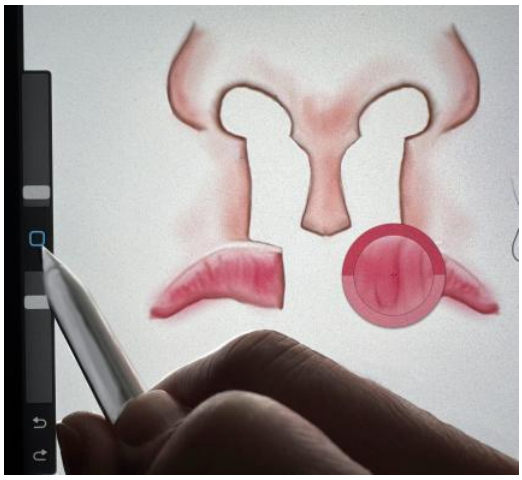
8. Color wheel
   a. Click on the circle at the upper right corner of the screen

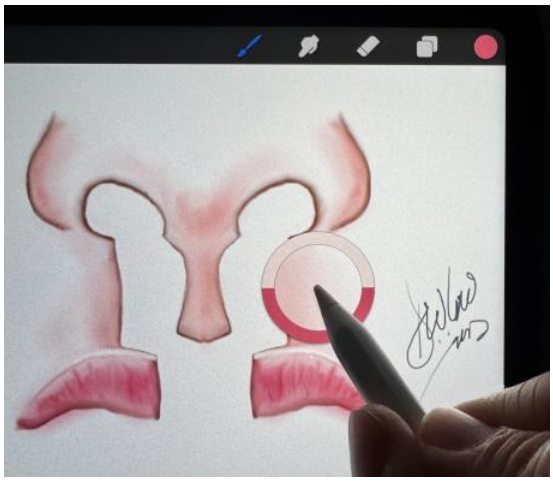


b. Pick a color and intensity from the color wheel by dialing the outer circle and clicking on the inner circle
c. You can also match the color of part of your picture by pressing and holding your fingertip on the screen until a small colored semi-circle appears, and the color you want should appear in the in the top half of the circle, and also in the small circle at the upper right corner of your iPad. You can roll your fingertip in an area that has many colors until your desired color appears in the circle.



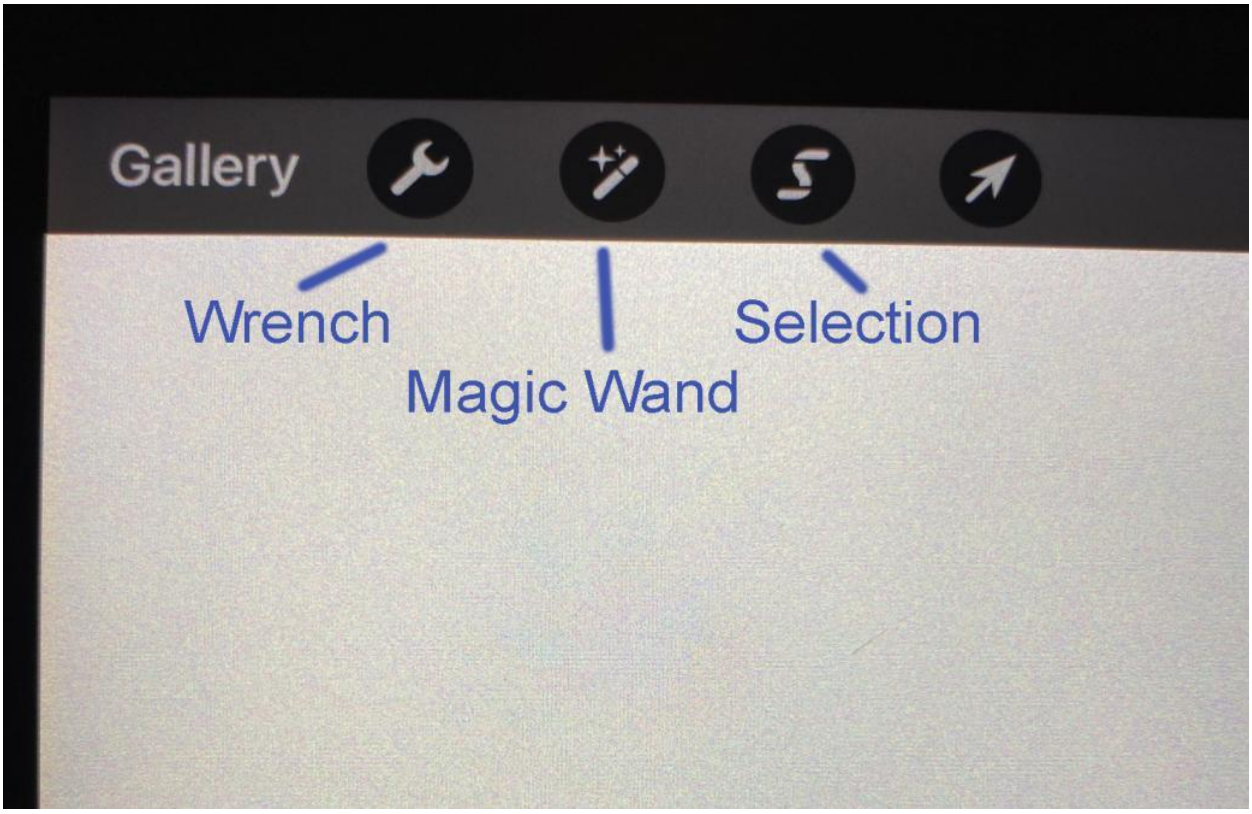
d. Another way to match your color is to touch the small box between the brush size and opacity bars. Tap it sharply with your iPencil tip, and the box should briefly turn blue. You should also see the color wheel appear somewhere on your screen



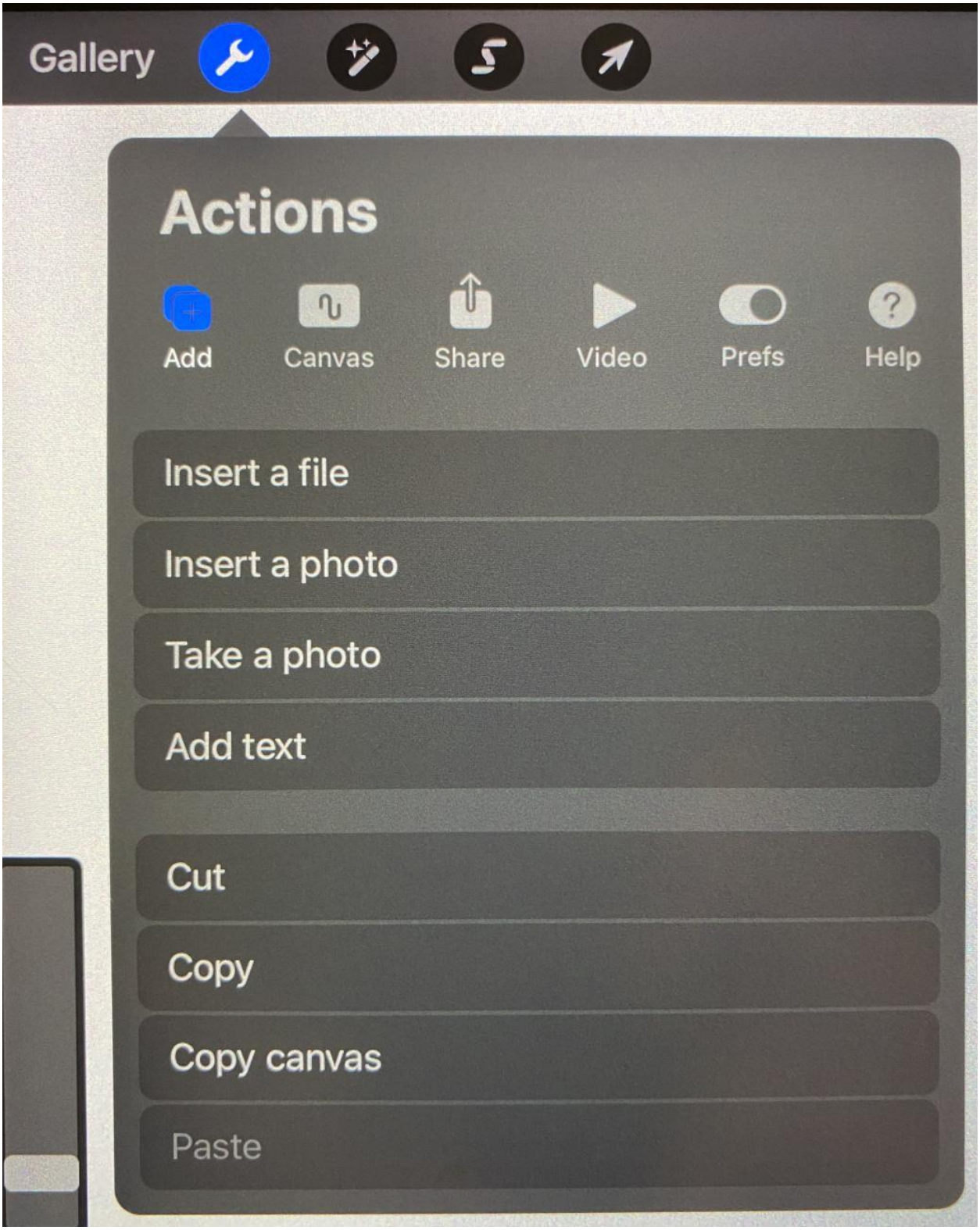


Click the color your want to match on your drawing. The color should appear in the top half of the circle, and it should also appear in the top corner of your screen

9. The eraser – you can adjust the size and opacity of the eraser, similar to the brush
10. The smudge tool – very useful for blending colors and removing blood spots and blemishes.
    a. You can adjust the spot size and intensity of the smudge tool
    b. Drag the color you want onto the color or areas you want to soften or blend
11. The left upper corner

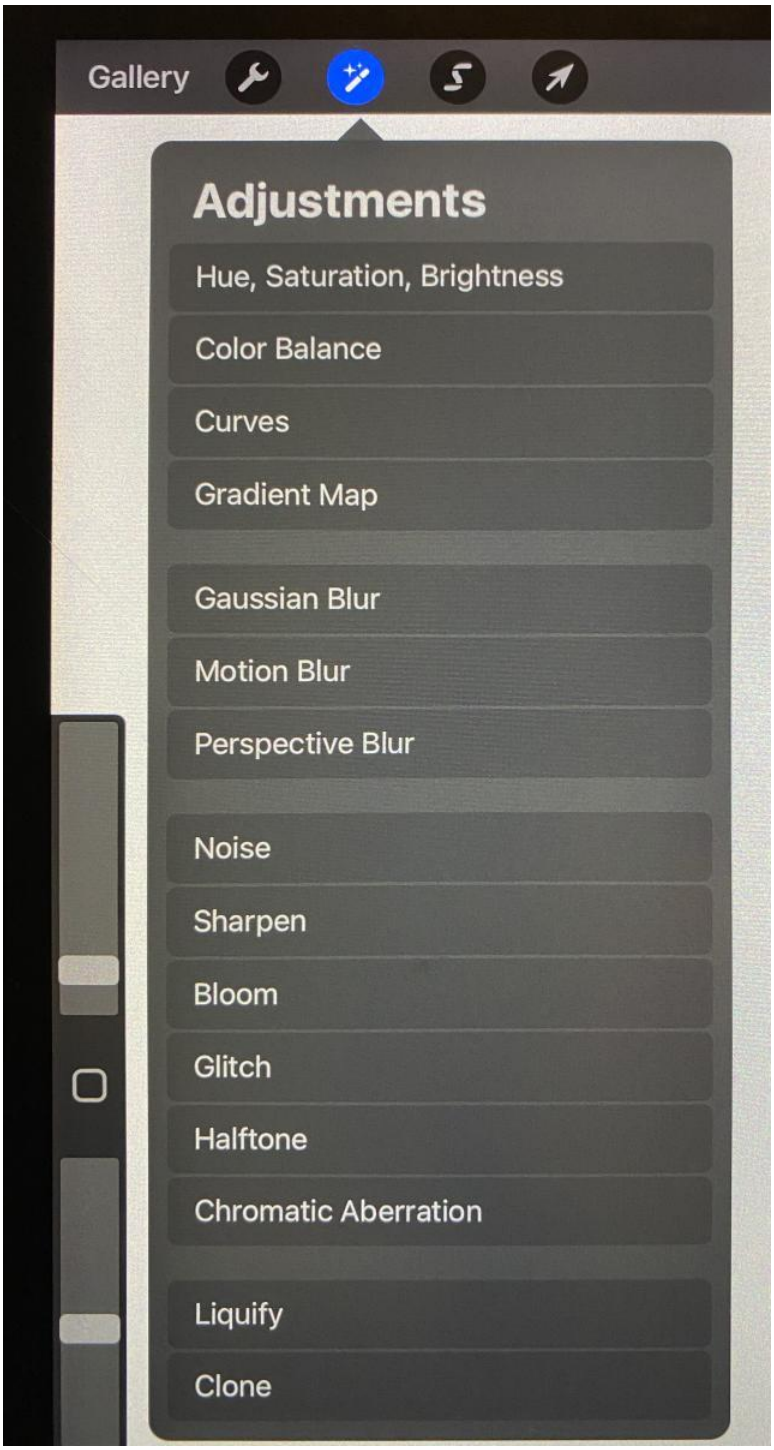


12. The Wrench tool



13. The Magic Wand
    a. Similar to photoshop, you can adjust your photos (hue, saturation, brightness, etc)

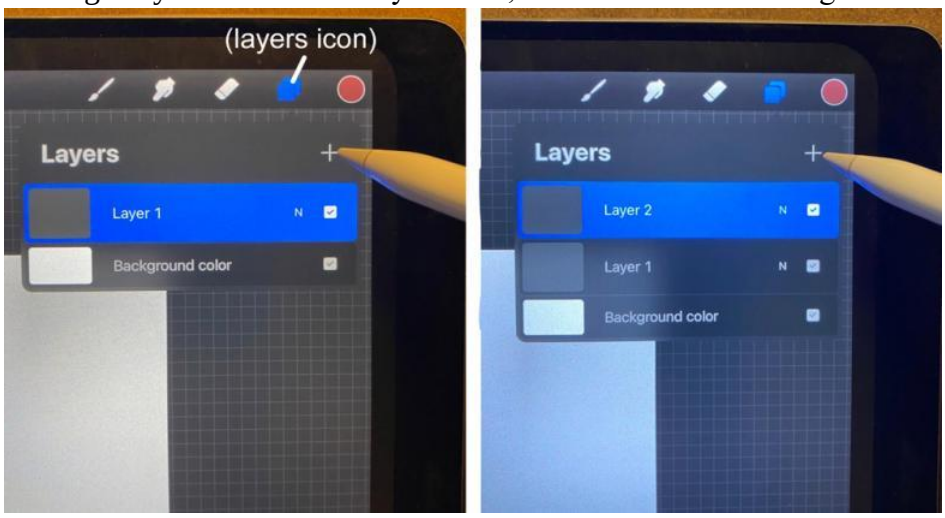
b. At the bottom, Clone and Liquefy tools are very useful, although they take some practice to master



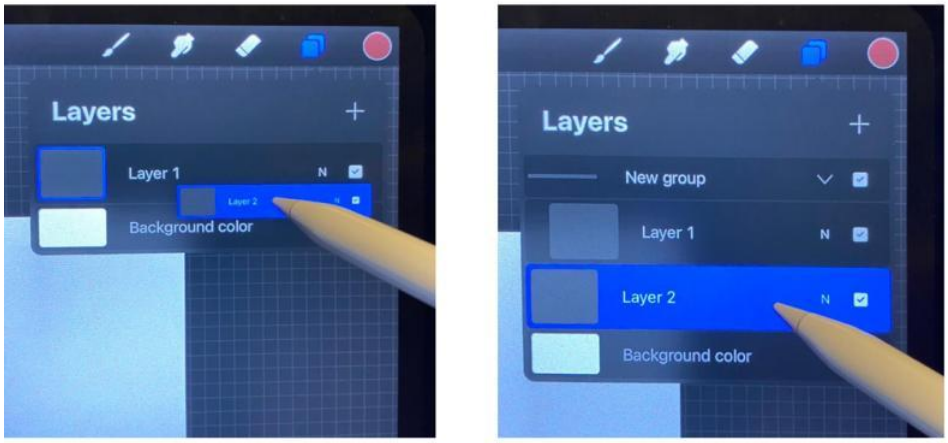
14. The clone tool – absolutely the most fun tool in "Photoshop", and Procreate also has a clone tool that works somewhat similarly. You can erase blood spots, moles, marking pen smudges, etc.
    a. Click on the clone tool, and a circle will appear on your screen.

b. Position the circle on the area you want to clone (copy)
c. You can adjust size and opacity where you will transfer the cloned area, but the circle designating the general area you are copying will stay the same size
d. Move your pencil to the desired target and start to color it in.
e. If you want to adjust what you are copying, drag the clone circle to a different part of your picture, then reposition your pencil on the target site and start to color it in.
f. Continue until you are happy with the clone process. If you start to clone something that is unintentional, just go backwards by tapping the screen with 2 fingers.

15. Introduction to layers
    a. Layers allow you to work on certain areas without affecting other areas, such as adding sutures or instruments to a drawing without affected the base drawing
    b. If you add labels (using photoshop or Procreate), they show up on a new layer
    c. If you paste something onto your drawing, it also shows up on a new layer
    d. You can merge layers if you want to simplify your drawing
    e. Adding a layer: click on the layers icon, then click on the "+" sign

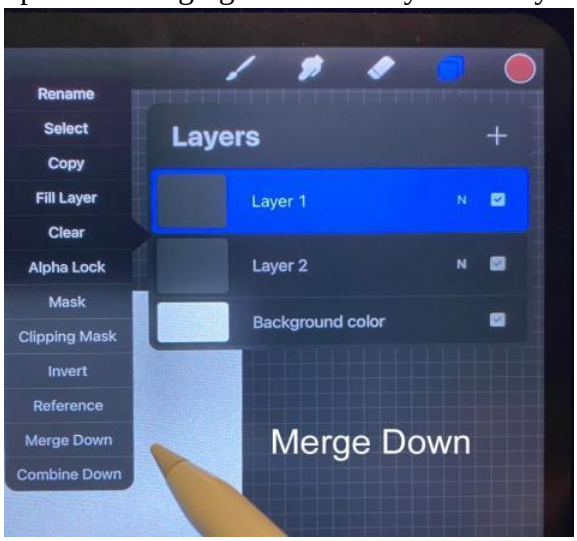


f. Restacking layers – you can hold your iPencil or finger on a layer and after it jiggles, you can drag it above or beneath other layers



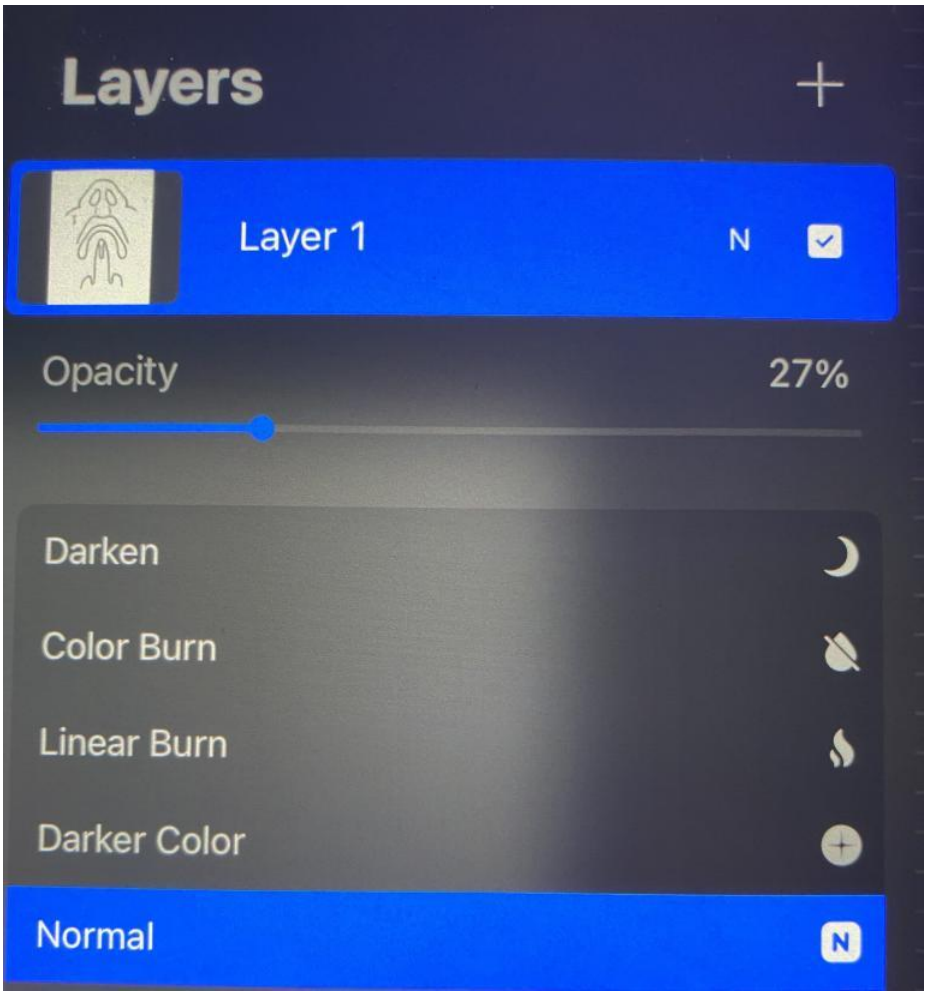
dragging Layer 2 underneath Layer 1

g. Merging layers – if you tap on an upper layer, a menu will appear that includes the option of merging it with the layer directly underneath it



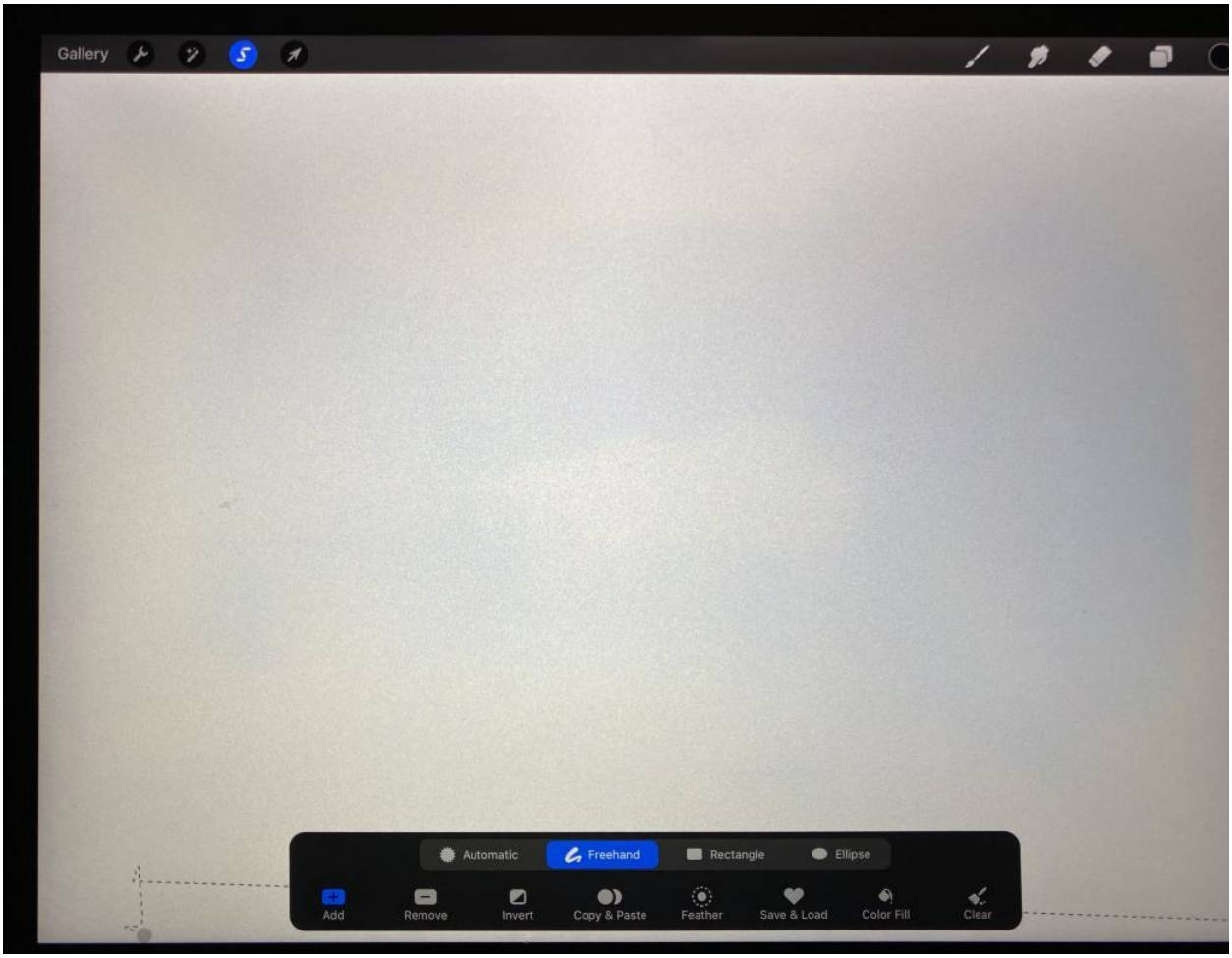
h. Sometimes a layer seems to hide deeper layers, for example when you have copied a line drawing and are trying to color on a layer below it. If this happens, you need to click on the upper layer (in this case Layer 1) , click on the letter N, and then drag the opacity to something less than 100% that allows your deeper layer to be seen

i. You can also remove an undesirable layer by clicking “clear” or unchecking the box.

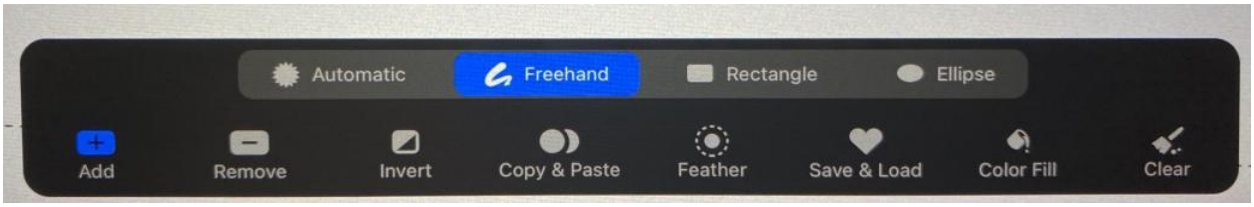


16. A few tricks with Procreate that are very useful
    a. Going backwards with the two finger tap
    b. Going backwards and forwards with the arrows
    c. Drawing a straight line – draw your desired straight line and keep your iPencil on the screen – after a couple seconds it will become a perfectly straight line. If you didn't mean to draw a straight line, just tap the screen with two fingers and it will go back to your original crooked line
    d. Drawing curves and geometric shapes – draw your desired curve or geometric shape and keep your pencil on the screen – after a few seconds Procreate will smooth out your shape. (note – very subtle curves may unfortunately turn into straight lines). Again, if don't want a smooth curve, tap the screen with two fingers to go back

17. The Selection Tool

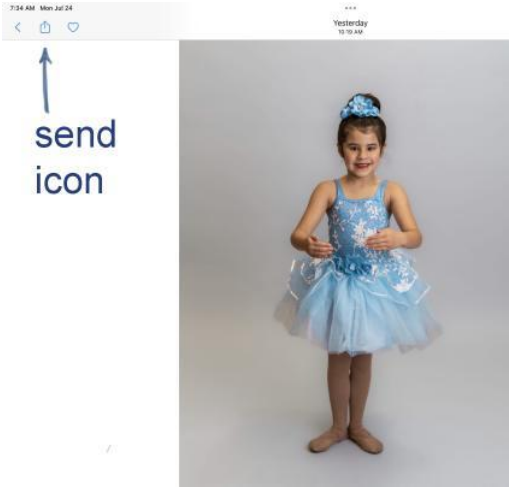


a. Freehand vs rectangle – outline the area you want to copy or cut



b. Then click on the wrench icon to Cut or copy, and paste. After pasting you can resize, rotate, flip, distort, and/or warp it. Whatever you paste will initially be on a new layer, but you can merge layers later if you wish.
c. Pasting parts of drawing or photos will be very useful if you are doing a step-by-step series of operative drawings. It is also useful for adding missing people to a group photo, and you can easily adjust the size, location, lighting, and hue to seamlessly blend your pasted image. Since it is on a different layer, you can also erase whatever parts should be hidden by people or objects in front of the added person.

18. Pasting photos
    a. Go to the photo library on your iPad, or find an online photo and take a screen shot of it
    b. Click on the photo and copy it
    c. Open the Procreate app and paste it onto your canvas
    d. Alternatively if you click on the photo and then the "send" icon (the box with the arrow) you may be able to send it directly to Procreate. Click on the Procreate icon and the photo should transfer automatically. When you open the Procreate app it should be in your gallery as the most recent item



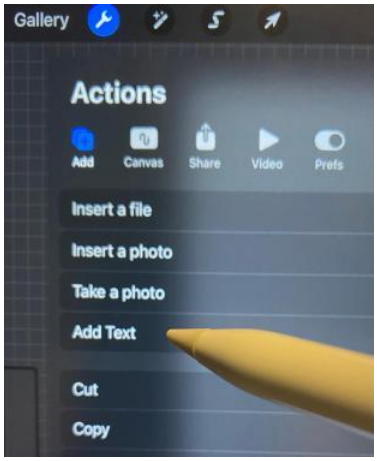
    e. You can adjust the position, size, orientation, etc. right after you paste it
    f. Anything you paste will be on a new layer, and sometimes you may need to drag that layer to the top to see it. You can also merge layers to simplify things.
19. Pasting surgical instruments
    a. Create your own collection of photos of surgical instruments
        1. Circle the instrument you want from your collection, copy it and paste it onto your drawing. You can adjust size, rotation, flip it, erase parts of it, etc.
        2. The instrument will be on a separate layer, and you may have to drag it above the layer that has your drawing to see it. Later you can merge layers if it gets too confusing.
20. Other fun tricks with Procreate
    a. Retouching photos – the clone tool and the smudge tool can be used with great effectiveness
        1. Removing red eye (retina light reflection)
        2. Removing blood from your photos
        3. Adding clean drapes
        4. Removing blemishes
        5. Pasting open eyes in group photos – you can easily adjust size, rotation, lighting, and hue to seamlessly correct anyone whose eyes are closed, if you have a different photo of them with open eyes. Use the selection tool to copy their eyes or even their

entire face, and paste it onto your initial group photo. Ideally, you want the clarity of the two photos to match or your edit may be detectable.

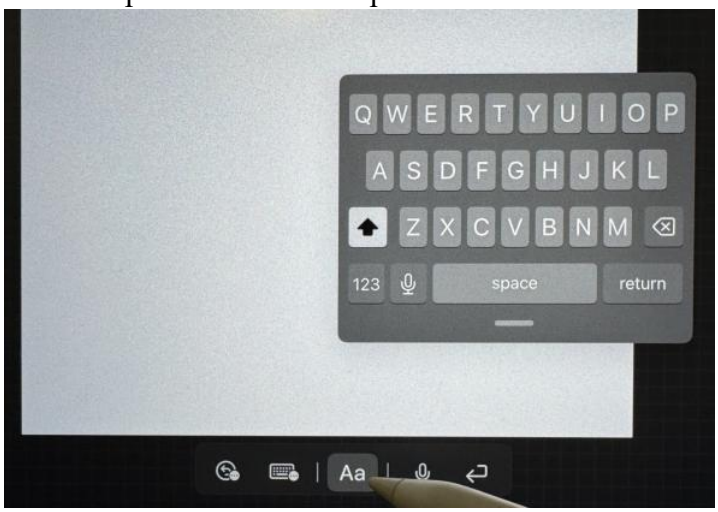
b. Tracing photos – add a layer over your pasted photo, trace the key lines, then delete the photo. No one needs to know you traced it

21. Adding labels and leader lines –

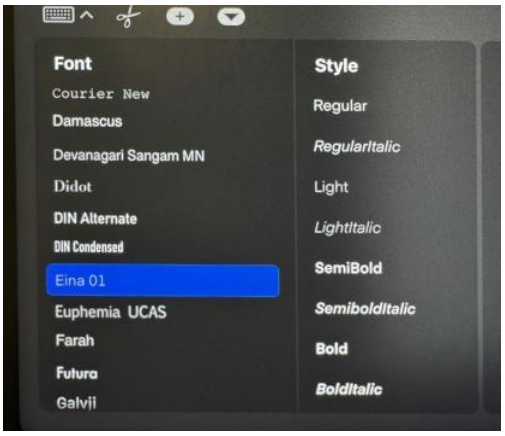
a. Adding text with Procreate: Start by selecting the color of the text using the color wheel. Click on the wrench tool and click on "Add Text".

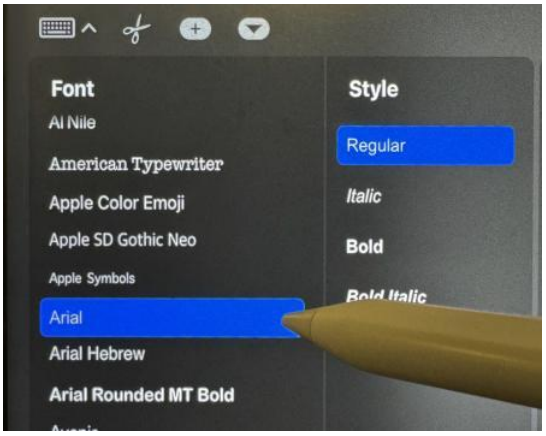


b. You will see a text box appear and a keyboard, and usually another box with"Aa" for font selection. If you don't see the "Aa" start again, or sometimes clicking on the microphone seems to help. Click on the "Aa"

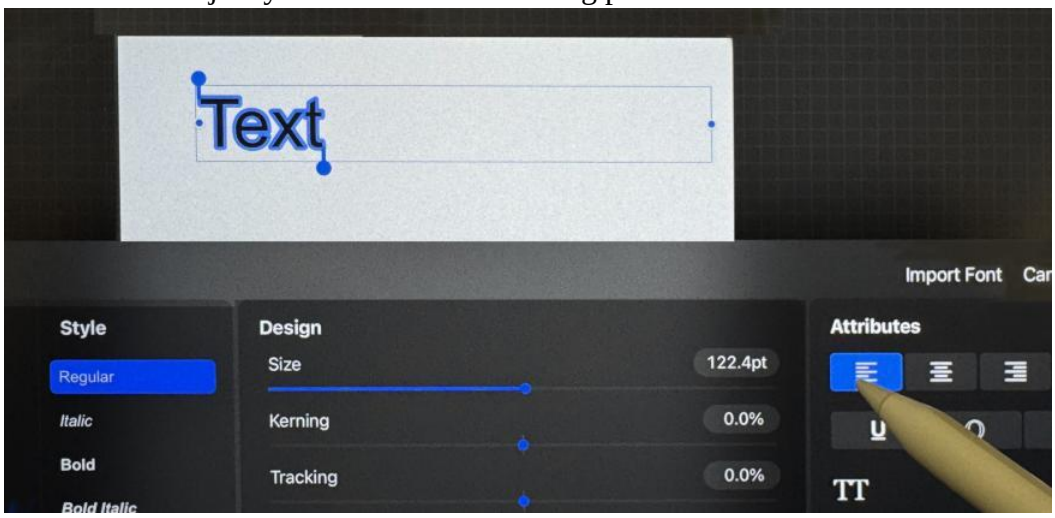


1) When you select your font, you will have a variety of fonts available to you. For some reason Procreate defaults to Eina 01, but I most commonly scroll up to Arial Regular when I am labelling illustrations because it is simple and easy to read.

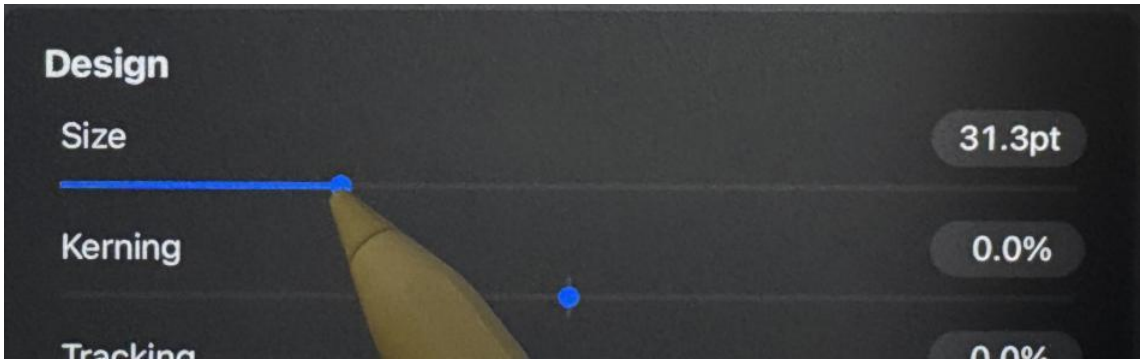




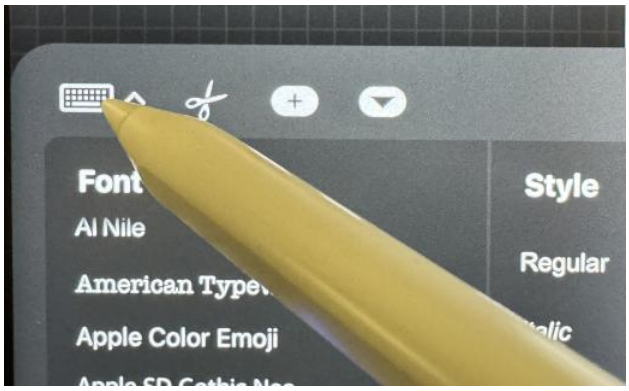
You can also adjust your font size and starting position.



I prefer to start typing at the left side of the text box, so I click the left box under "Attributes".

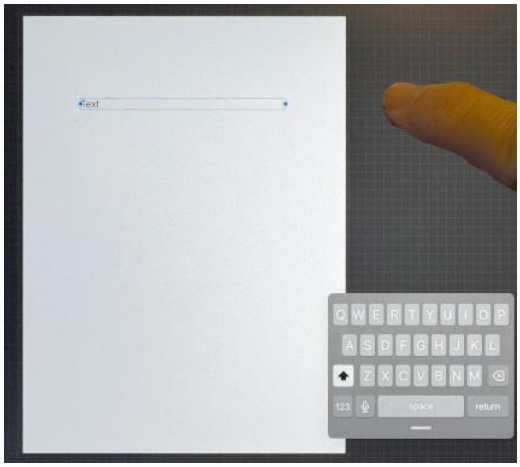


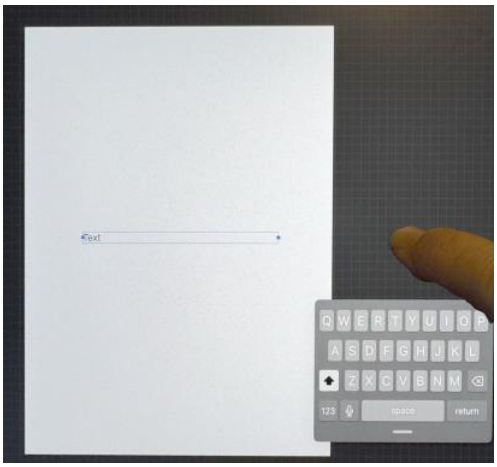
Use the iPencil to pick the desired font size, and it is useful to take note of the size number (in this case 31.3pt), or type in your desired size number so your labels are consistent. For more important labels, you can choose "bold" style and/or a larger font size.



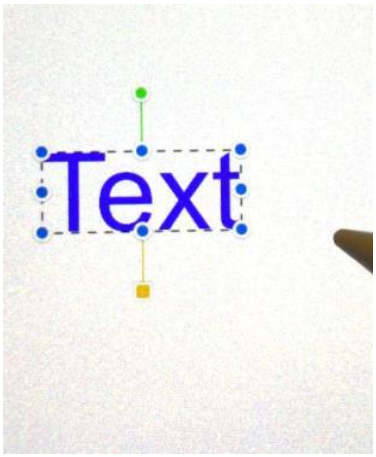
When you click on keyboard icon, sometimes it is a small keyboard and sometimes it is a large keyboard – I can't figure out why, but usually I get the small one and use my iPencil to type the label

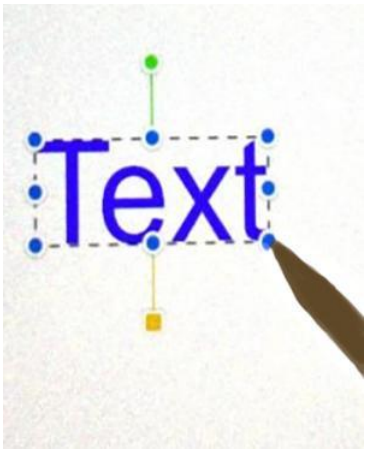
2) Positioning the text box can easily be done with your fingertip by dragging it outside your canvas. Don't worry if your text size and position are not exactly what you want. The text labels are on a different level and can easily be cut, pasted, repositioned, and resized



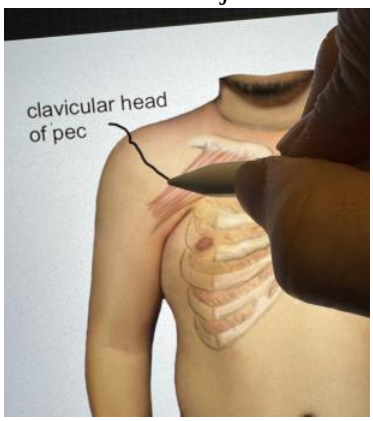


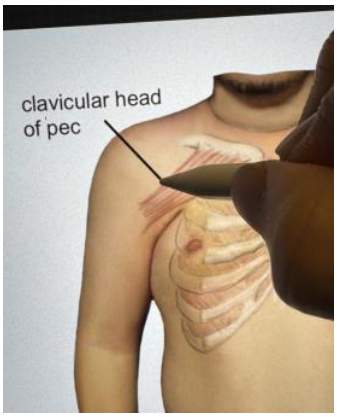
3) I use the rectangular selection tool to make a box around the words I want to change, then select cut and paste. The text will disappear and then reappear in a form that one can resize and drag anywhere

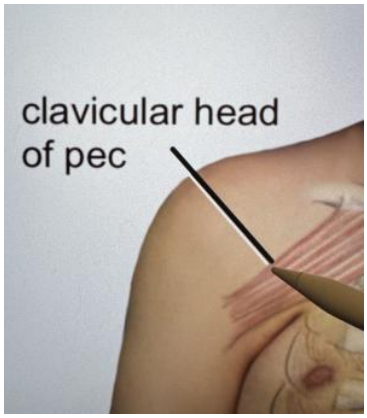




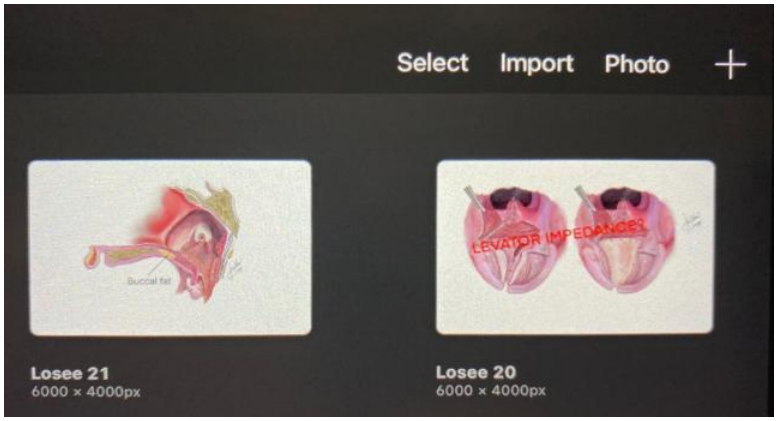
4) If I have a lot of labels, I find it easier to type them all on a blank canvas and then individually cut or copy a piece of text and paste it onto my illustration.
5) You can easily add leader lines from the labels to the relevant parts of your illustration by drawing lines and holding the pencil on the iPad until it straightens out. If it is difficult to see a black line over a dark part of your drawing or photograph, you can add a thin adjacent white line to make it stand out

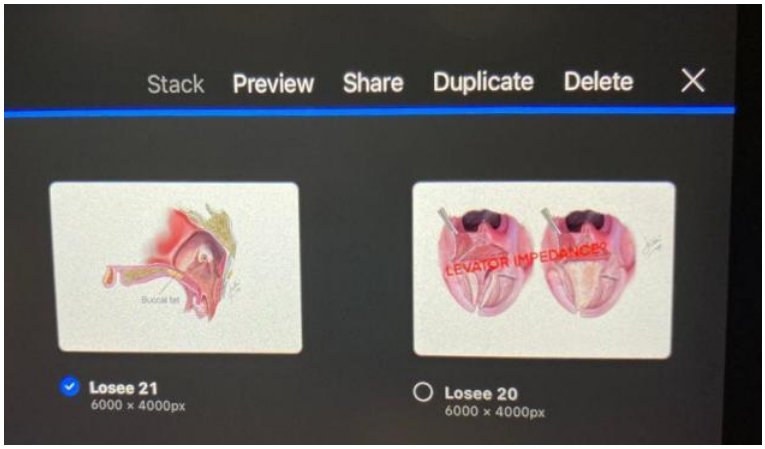




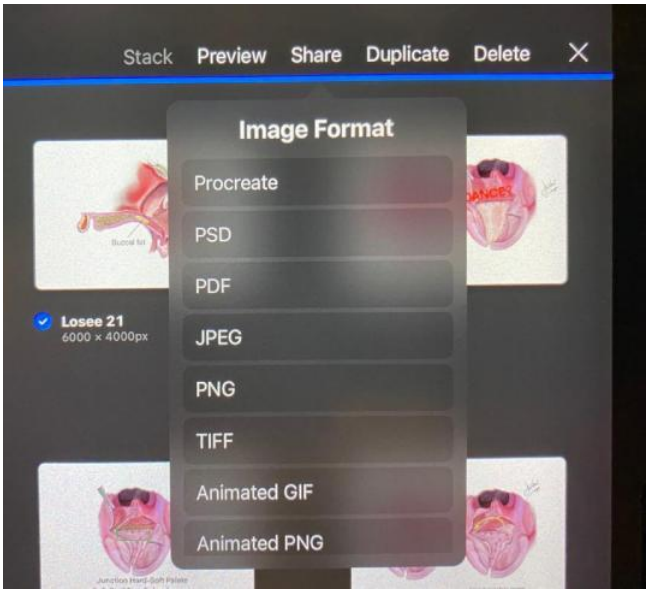


22. Miscellaneous tips:
    1) Illustrating a surgical step-by-step procedure – create a basic drawing and paste it repeatedly, changing only the area that is being altered. This will avoid having to start from square one with each step
    2) Preparing illustrations for publication
    a. Some publishers will insist on 300 dpi resolution for their photographs and illustrations. Photoshop (not Procreate) can easily do this.
    b. Open a photo or illustration in Photoshop. Then select “image”. On the drop down list, select “resize”, then “image size”, and then “resolution (pixels/inch)” If the number is less than 300, just change it to 300. Be aware that it may significantly increase your file size. This may make it difficult to send it via regular email, and you may need a dropbox if transporting many illustrations.
    3) Exporting your drawing from your iPad:
        a. Go to the gallery that shows all of your drawings and click on “Select”. Then click on the illustration(s) you want to export

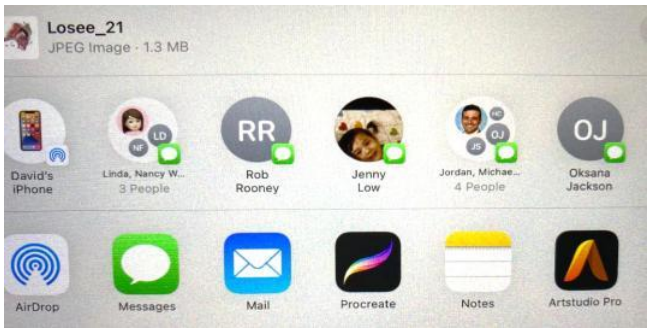




b. Then click “Share”. It will then give you a variety of formats, of which “JPEG” is the one I use



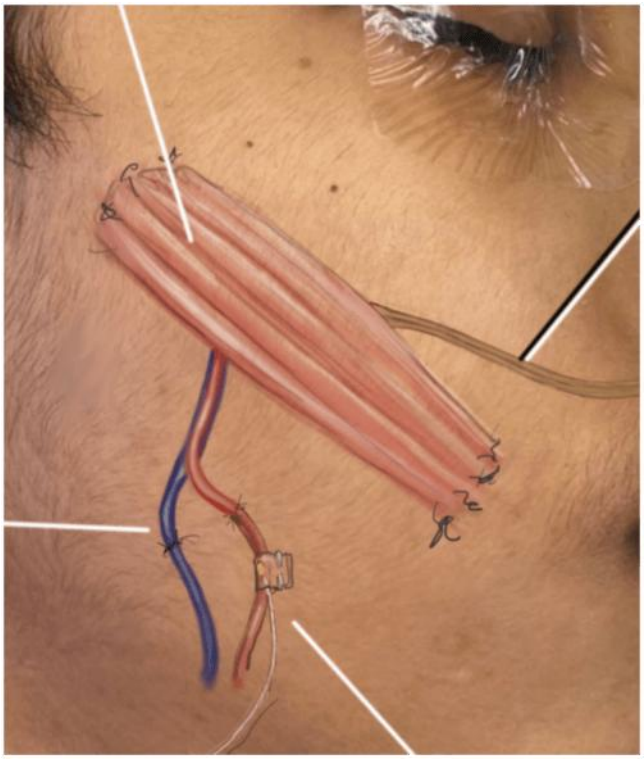
c. After you click on JPEG, it will give you options such as airdrop and email. I usually type in an email address and then send.



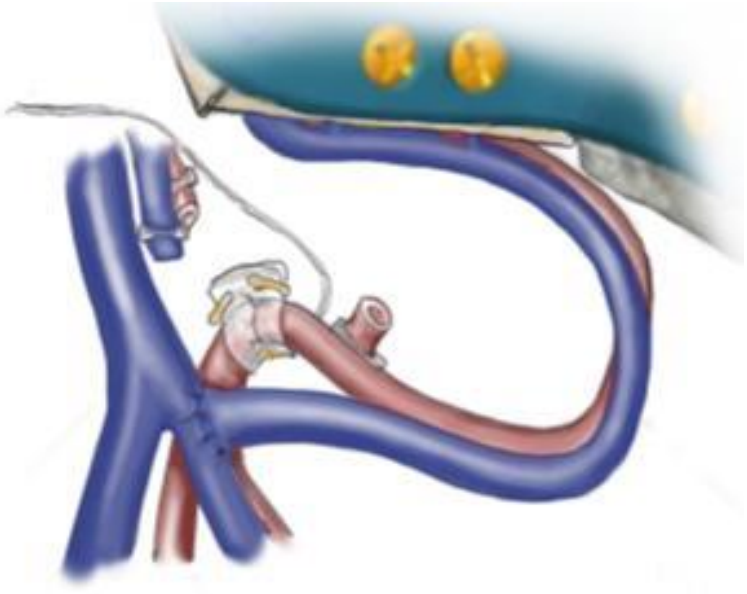
23. Exercises
    a. Basic line drawing of normal nose, lip, alveolus, and palate
    b. Adding color to your line drawing
    c. Pasting a photo, adding a new layer and tracing the key portions, then deleting the photo
    d. Adding instruments
        1) Take photos of your most commonly used instruments, or use the instrument sheets in this handout
        2) Paste your photos on a blank Procreate canvas and erase any background around each instrument
        3) Use the
        4) Click on the Selection tool, Freehand, to trace your desired instrument
        5) Click on the Wrench tool, click copy
        6) Go to your drawing, click the Wrench tool, and click Paste
        7) Your tool will appear on a new layer, and at this point you can resize and rotate it. You can also flip it and distort it. You can erase parts of it if you don't want to show the entire instrument. I usually do not merge it with the underlying illustration so I can continue to use the base drawing in other illustrations.
    e. Drawing sutures

1) Always add a new layer so you don't mess up your underlying illustration
2) I personally use Airbrush/Hard Brush, 100% opacity and pick a color that matches my suture color. For the needle, I tend to use black and make the thickness slightly wider than the suture width.
3) Draw a semi circle or semi oval for the needle and hold the pencil down until Procreate makes a smooth curve. Use erase to get a sharp tip at the pointed end.
4) Switch to Airbrush/Soft Brush/White/very low opacity and carefully start to shade your needle to get a reflective shine. You can later add high opacity white to get a sharp light reflection.
5) You can also color your sutures, using soft brush, low opacity, and the color of your choice, taking care to stay within your hard borders. You can also use the smudge tool to blend irregularities in color intensity. Magnifying your drawing by expanding two fingers on the screen makes this step much easier.

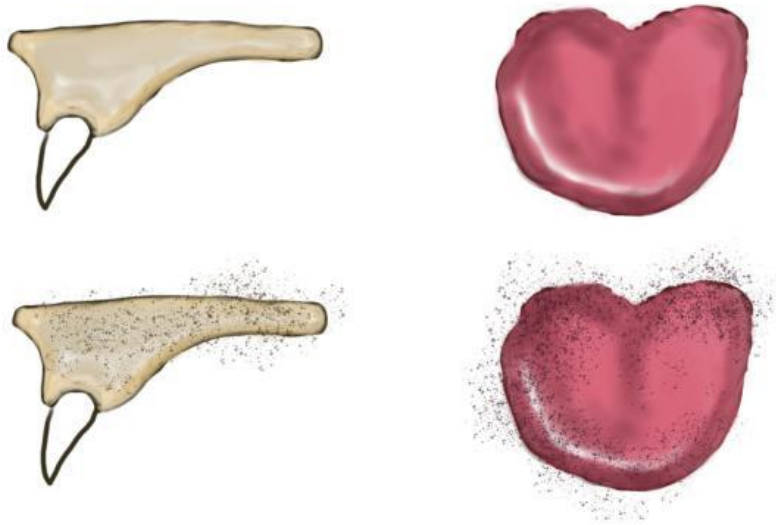
f. Drawing muscles
   1) Make a series of parallel line with the soft airbrush, dark reddish-brown
   2) Insert parallel lines of a lighter brown between your original lines
   3) Use the smudge tool to blend the lines a little
   4) Add dark lines and white lines for shadows and highlights



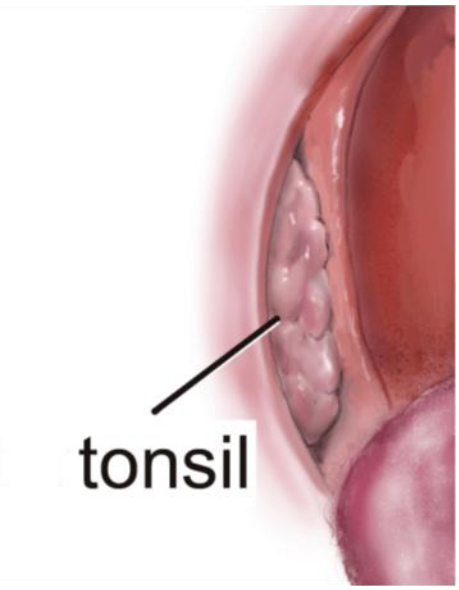
g. Drawing blood vessels
    1) Use a hard airbrush, dark bluish grey, high opacity to make a vein outline
    2) Use a soft airbrush, smaller brush size, white color with low opacity to begin to add light reflection to the vein
    3) Use the smudge tool to help blend the shades
    4) Add bright white highlights (white with high opacity) for a wet reflection
    5) For arteries, start with a dark reddish brown, then add lots of white and lots of smudge tool to blend everything



h. Drawing bones, bone marrow
    1) I tend to draw the bone outline with dark grey, then shade with lighter colors
    2) For bone marrow, add a new layer, choose the Spraypaint – Flicks brush, a dark color, and vary the size and opacity of your brush. The splatter will be everywhere, which is why you are doing this on a new layer.
    3) Use the eraser to remove the splatter from unwanted areas
    4) Merge the two layers if you wish
    5) I use this same technique when drawing a tongue to simulate all the papillae, or for uneven texture on mucosa



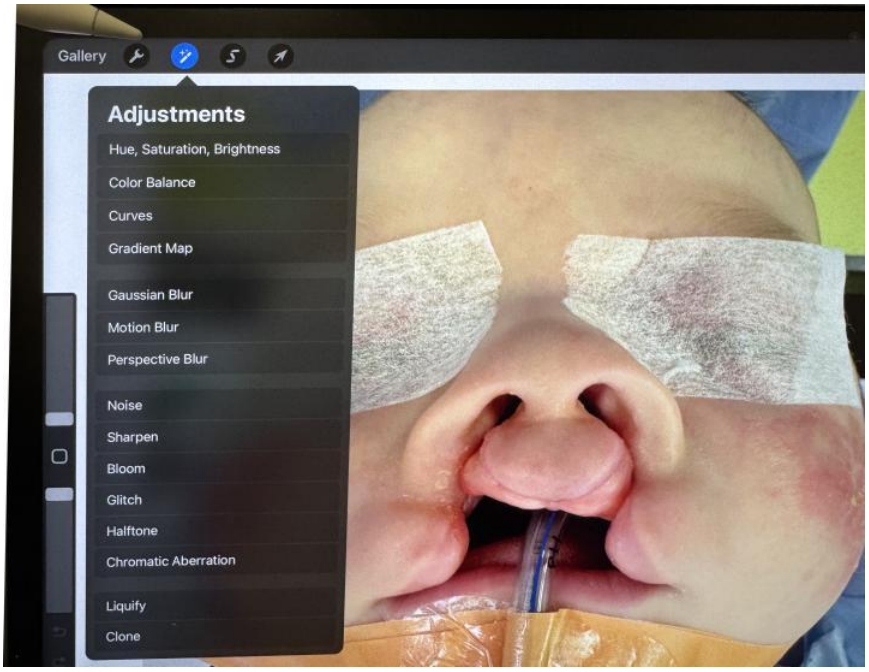
i. Drawing fat and glands
    1) Using a soft airbrush and brownish color, medium opacity, make circles and ovals to simulate fat globules. Switch to various shades of yellow to partially fill in the globules. Use the smudge tool to help blend the colors.
    2) Switch to white soft airbrush to create light reflections in the globules, varying opacity to get soft and wet reflections as desired
    3) For glands, use tan, red, and pink pigments
    4) Optional fine blood vessels using a small brush and red or blue pigment



Advanced Procreate skills

Once you have experience with basic digital illustration techniques, you can incorporate some of the magic wand features to expand your creativity and make publication quality illustrations and photographs

A. The magic wand adjustments options:

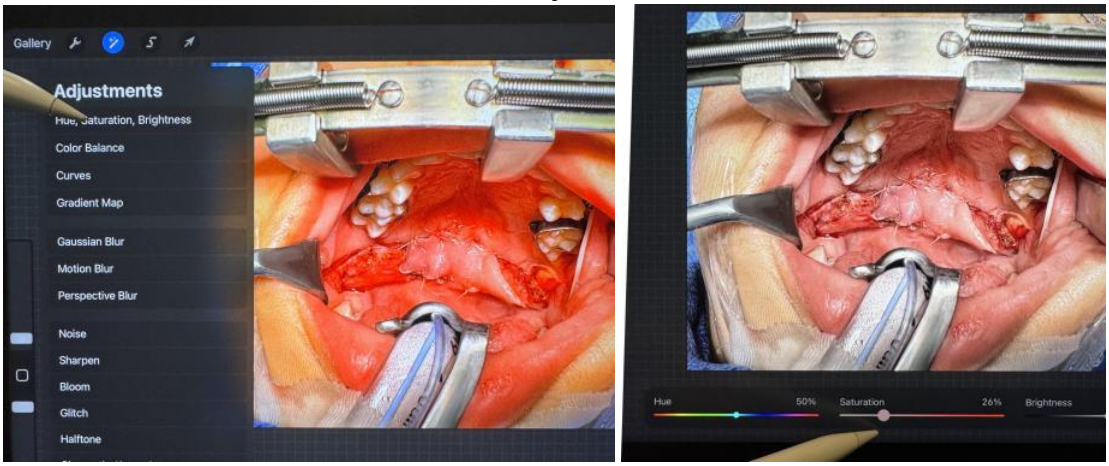


The most useful ones are

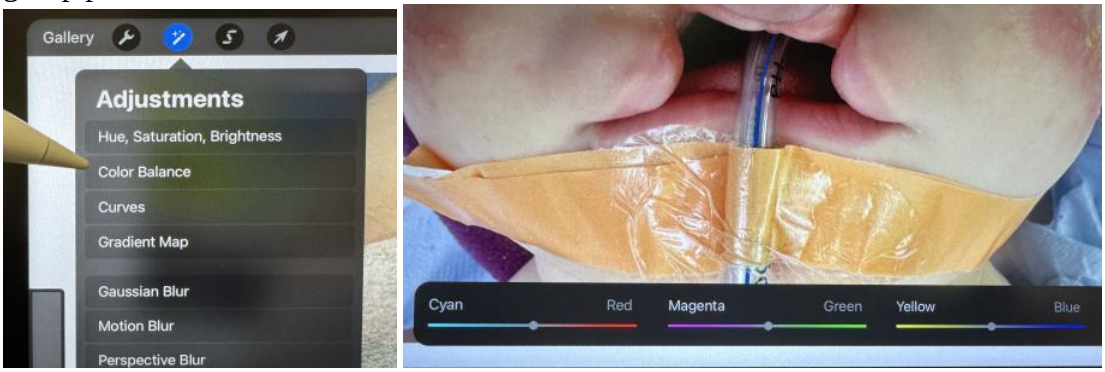
1. Saturation
2. Color Balance
3. Curves
4. Liquefy
5. Clone

(The others ones are useful if you want to create artistic blurring, lighting, and color distortions)

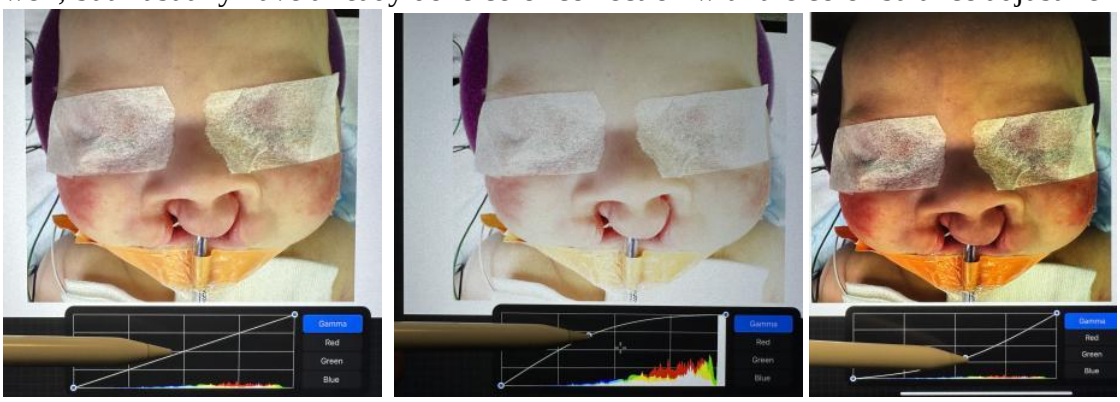
1. Saturation – intraop photos are often too red, and decreasing the saturation will help normalize the colors and increase the clarity



2. Color balance – adjusting individual hues can help match before and after photos so the skin colors are more consistent. Also useful when you are pasting missing people into group photos, if the color is off.



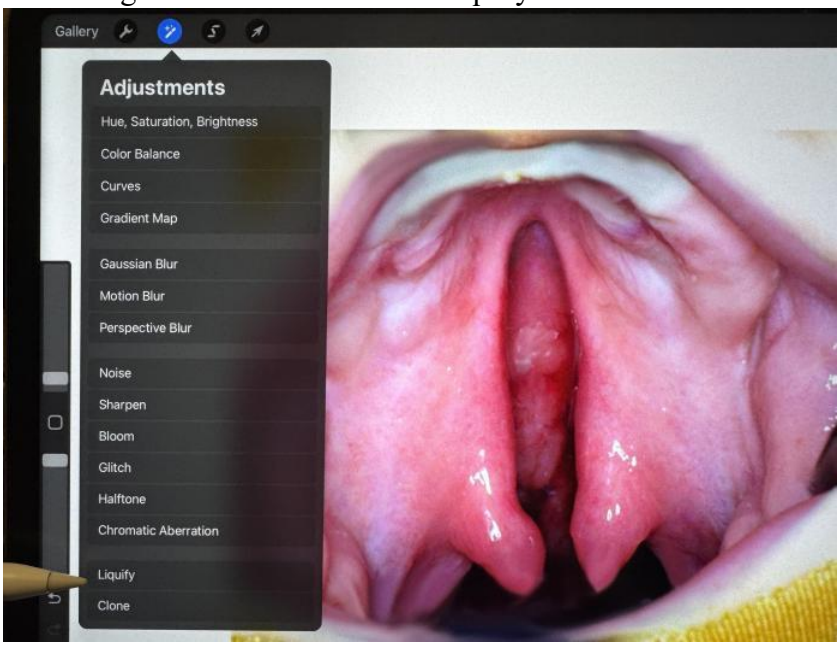
3. Curves – I find the Gamma adjustment to be extremely useful for adjusting lighting and contrast. Place your iPencil at various points along the line and drag it around to adjust lighting and contrast. This is very helpful when correcting lighting inconsistencies in before and after photos. You can experiment with the red, green, and blue color curves as well, but I usually have already done color correction with the color balance adjustments



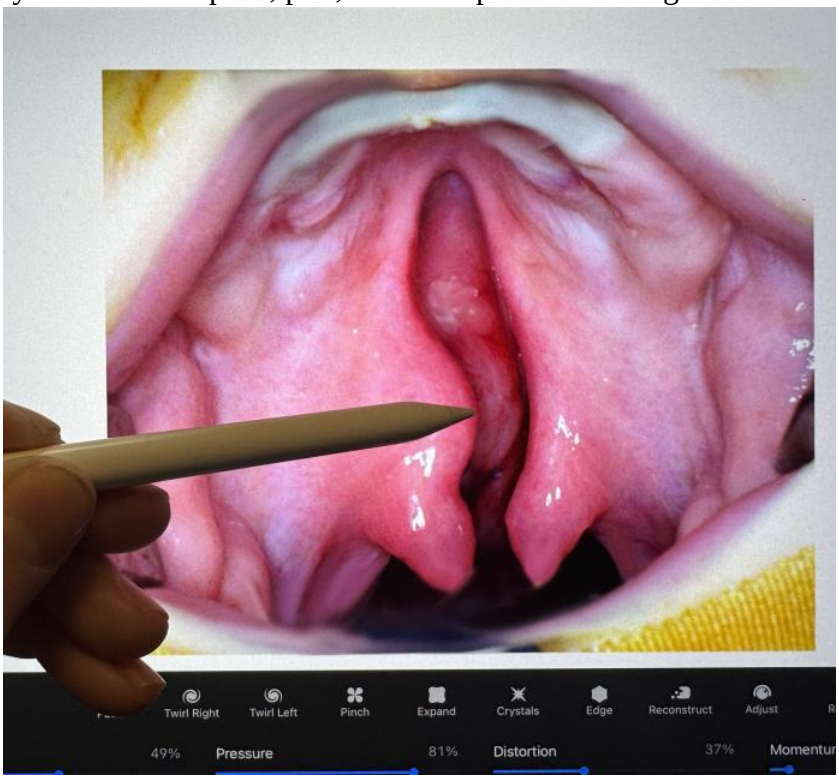
4. Liquefy –

   This will take a lot of practice to master. It's almost like animation, but very challenging to get it right

   a. Click the magic wand and then click "liquify"

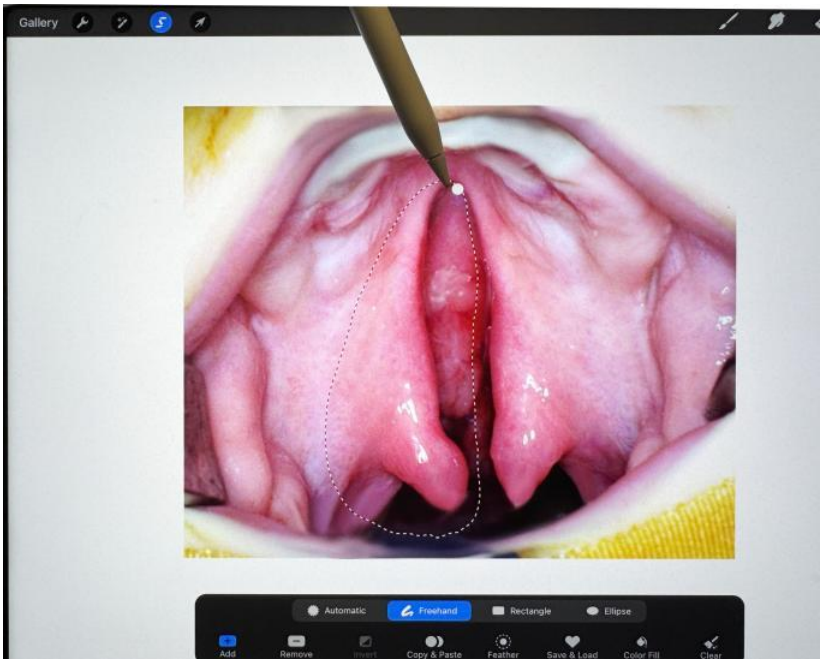


   b. Use your iPencil to push, pull, or distort part of the image to the desired area.

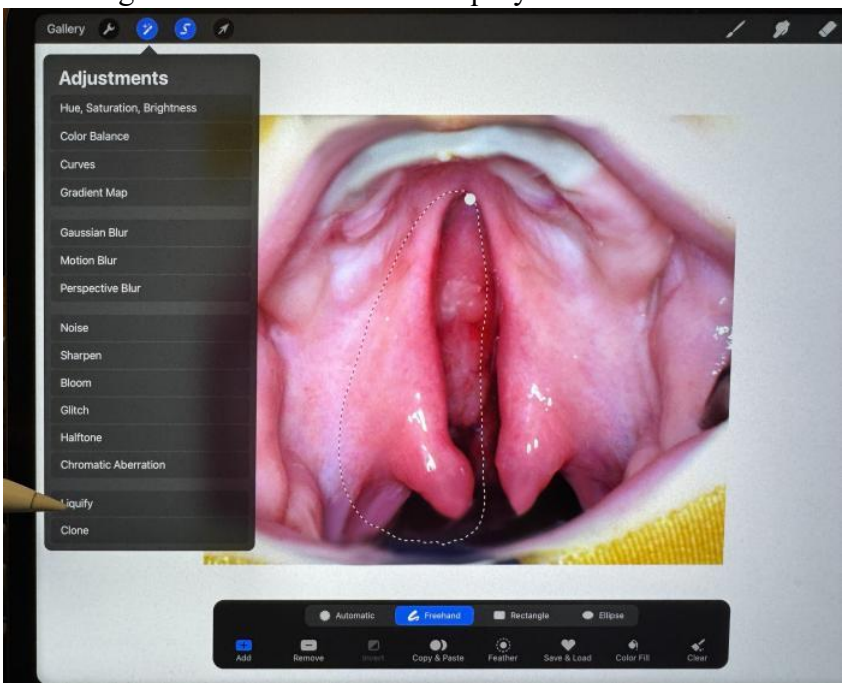


   c. If you want to limit what you are distorting, click the selection tool and choose "freehand"

d. Circle the area you want to shift and include the adjacent area to where you want to shift it



e. Click the magic wand and then click “liquify”

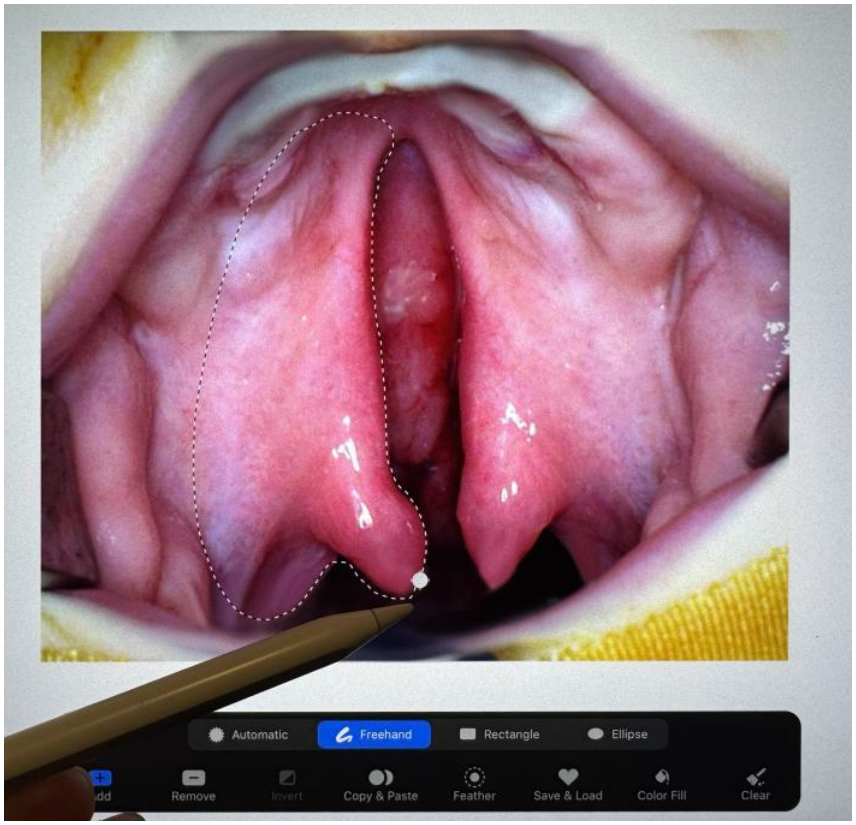


f. Use your iPencil to push or pull the image to the desired area.

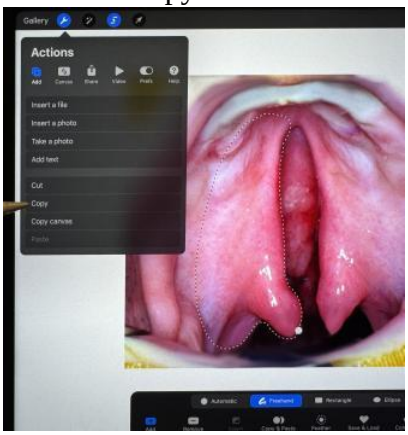
g. Switch to the smudge tool to smooth out any irregular areas
h. Be prepared to go backwards and try this repeatedly because it's somewhat tricky

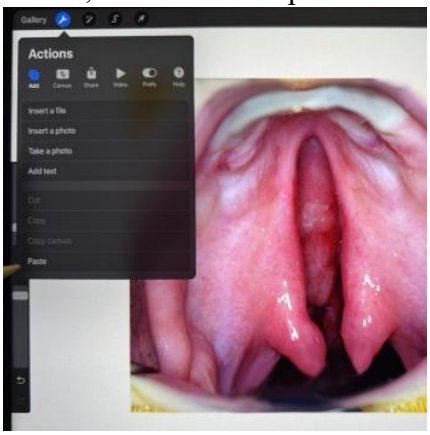
Alternatively, you may find it easier to copy and paste part of a drawing or photo and then click on "warp". You can then push or drag the pasted object to significantly change its shape, similar to the liquify maneuver.

1. Outline the area to be transposed with the freehand selection tool

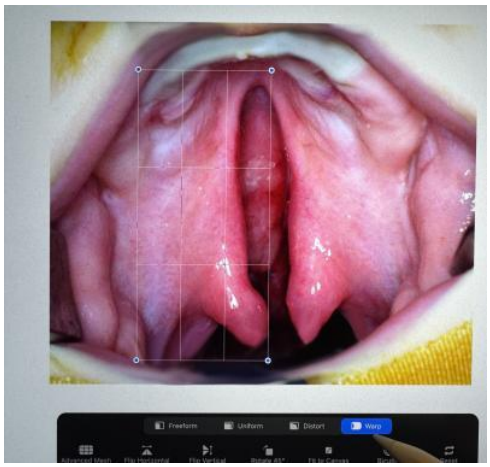


2. Click on “copy” under the wrench tool, then click on “paste”





3. After pasting, you will see a box at the bottom. Click on “warp”

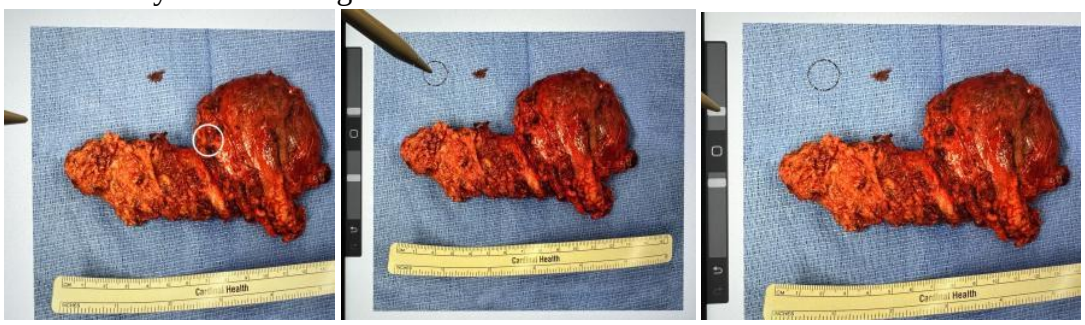


4. You will see a grid over the pasted area. You can drag portions of your pasted object as you wish. Remember it is on a new layer, so you may need to click on "Layers" to go to the original layer and remove portions of the original drawing that are still visible. Once you are happy with the appearance, you can merge the two layers if you wish

5. Clone
   a. This is similar to cloning with Photoshop, but you have to pay a lot of attention to the location of the circle to make sure you are cloning what you mean to copy. You frequently will need to reposition the circle with your pencil to adjust what is being cloned. In this example we want to remove the blood spot on the drapes.

   b. When you click on "clone" you will see a white or black circle on your canvas. Drag the circle using your iPencil or your fingertip to the area you want to clone. You can adjust the relative size and opacity of what you are cloning using the spot size and opacity settings on the tool bar on the left side. (The circle won't change size, but as

you start to clone, you will get a sense of how big an area you are copying and can adjust as needed). Also, you can magnify the drawing to zoom in and be very specific about what you are cloning.

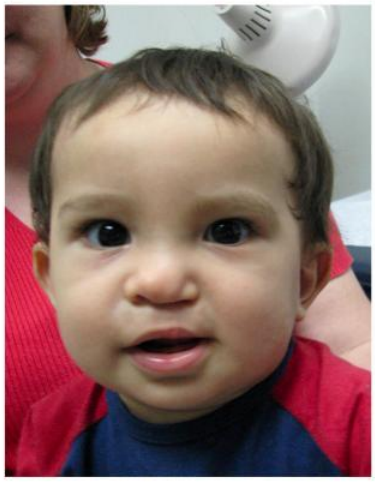
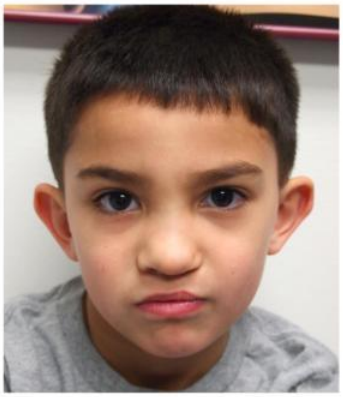


white clone circle is dragged to the area to be cloned adjust size and opacity

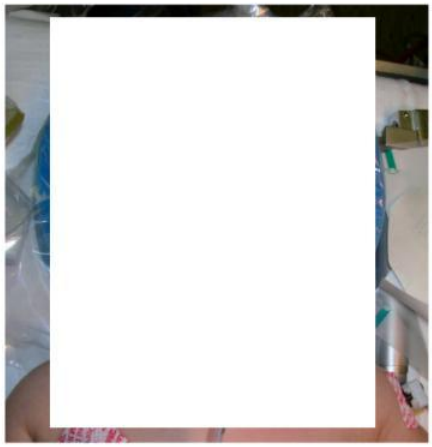
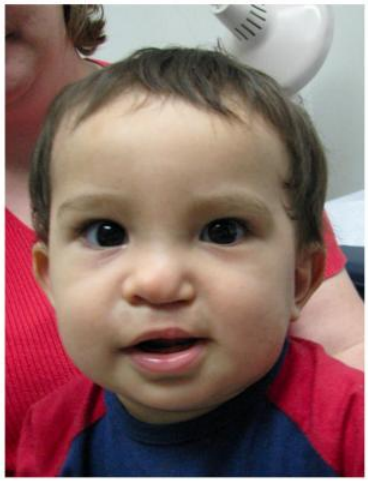
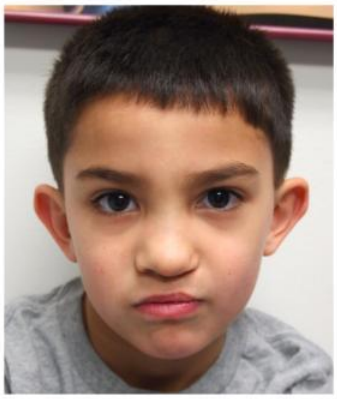
c. Take your iPencil off the screen and then place it where you want to clone over and make small circles as you visualize what is being copied. Note that the circle will also move as you clone, and if you stop and restart, you may need to reposition the circle repeatedly. In this example, the pattern of the drapes will nicely hide the blood spot.

B. Cropping and resizing your photos for presentation or publication

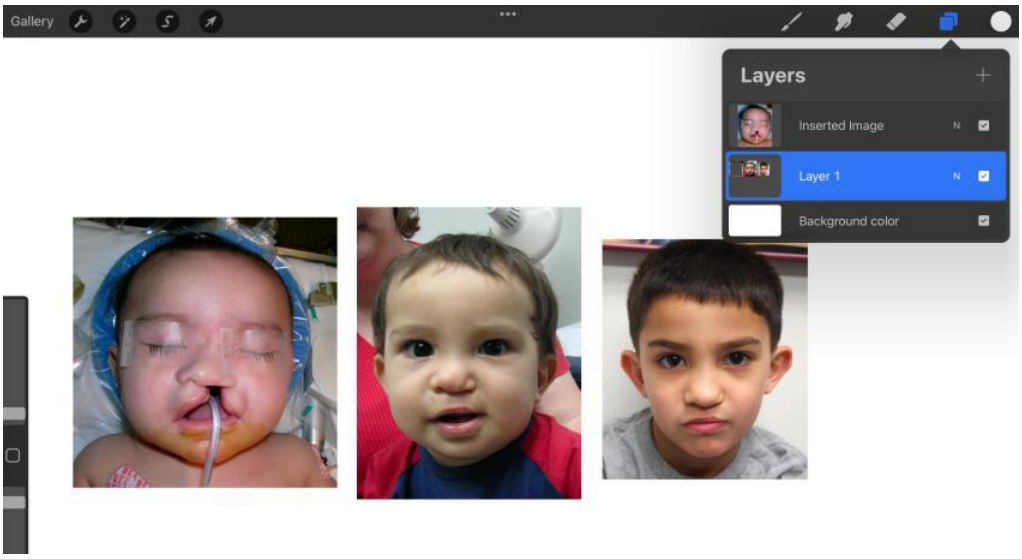
1. It's easy to arrange a collection of photos for publication or presentation by cropping, resizing and, if necessary, making minor adjustments in rotation, lighting, hue, saturation, and background
2. Example – before and after photos, but inconsistent magnification and distracting background

3. Use the rectangle selection tool to plan what you want to crop
4. Click “cut” and it will temporarily disappear. Click “paste” and it will reappear, but on a new layer. You can now adjust the size and rotation if you wish.

5. Click on “layers” and find the layer that has the cropped photo border. Click on eraser and completely erase the border, or you can also uncheck the box to make it disappear



6. You can cut paste, resize, reposition photos as often as you need to get a nice arrangement

7. You can erase a distracting background by using soft brush and a neutral color

8. You can adjust the color balance to make the middle photo more consistent (I increased the amount of red pigmention)

C. Pasting a photo and retouching it for a hyper-realistic drawing

1. Paste a photo on a blank canvas
2. Remove blemishes with the smudge or clone tool
3. Soften irregularities in color and texture as desired
4. Magnify features by spreading with two fingers and then highly eyelashes, eyebrows, irises, add white reflections to pupils, nose tips, lips, and teeth

Touching up your photos -
"Photoshopping" with Procreate

1) Correcting red eye
2) Correcting closed eyes (pasting open eyes from another photo)
3) Deleting someone from your photo
4) Adding someone to your photo
5) Removing background clutter or changing the background
6) Changing hue, saturation, brightness, etc with the magic wand
7) Cosmetic edits – removing wrinkles, webbed neck, double chins, extra weight, moles, pigmentary blemishes, pimples, tattoos, etc.

Procreate has many other brush styles and other features that you can explore and incorporate. Feel free to sample the wide range of patterns and textures at your leisure.

Exercise – cleaning up blood splatter (three different ways)

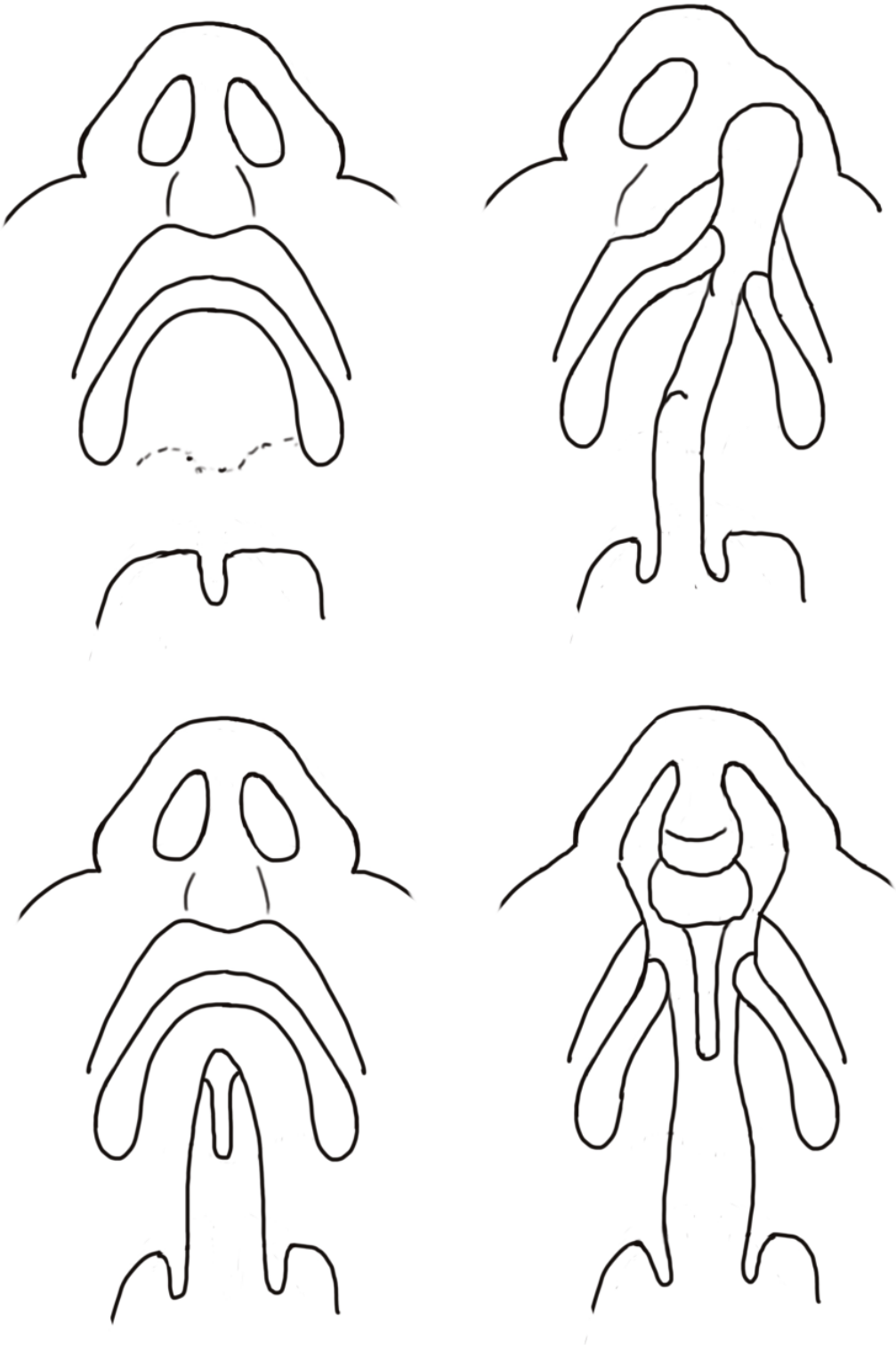
1. Use the smudge tool and drag clean skin color over the blood
2. Try holding your fingertip on the ET tube tape to pick up the tape color, then use your Soft Airbrush to color out the blood on the tape
3. Use the clone tool and clone clean skin over the blood (see cloning exercise below)
4. The clone tool works well for blood on textured surfaces like the towels and drapes
5. Extra credit – smooth out the wrinkled eye plastic patches with the smudge tool, or remove them completely with the smudge or clone tools

Cleaning up lots of blood splatter – more challenging

Cloning exercise:

1. Click on the Magic Wand and then click “Clone” at the bottom
2. Position the circle (may be white or black) over the area to be cloned (the clean drape)
3. Adjust size and opacity (you won’t actually see the circle change size, but what you copy will change size)
4. Position your pencil on the blood stain, and make small circles as you color over it
5. Pay attention to the circle and reposition it as needed to avoid cloning an undesirable area. It tends to drift as you color, (unlike the Photoshop clone tool)

Feel free to copy and paste, or trace these cleft outlines



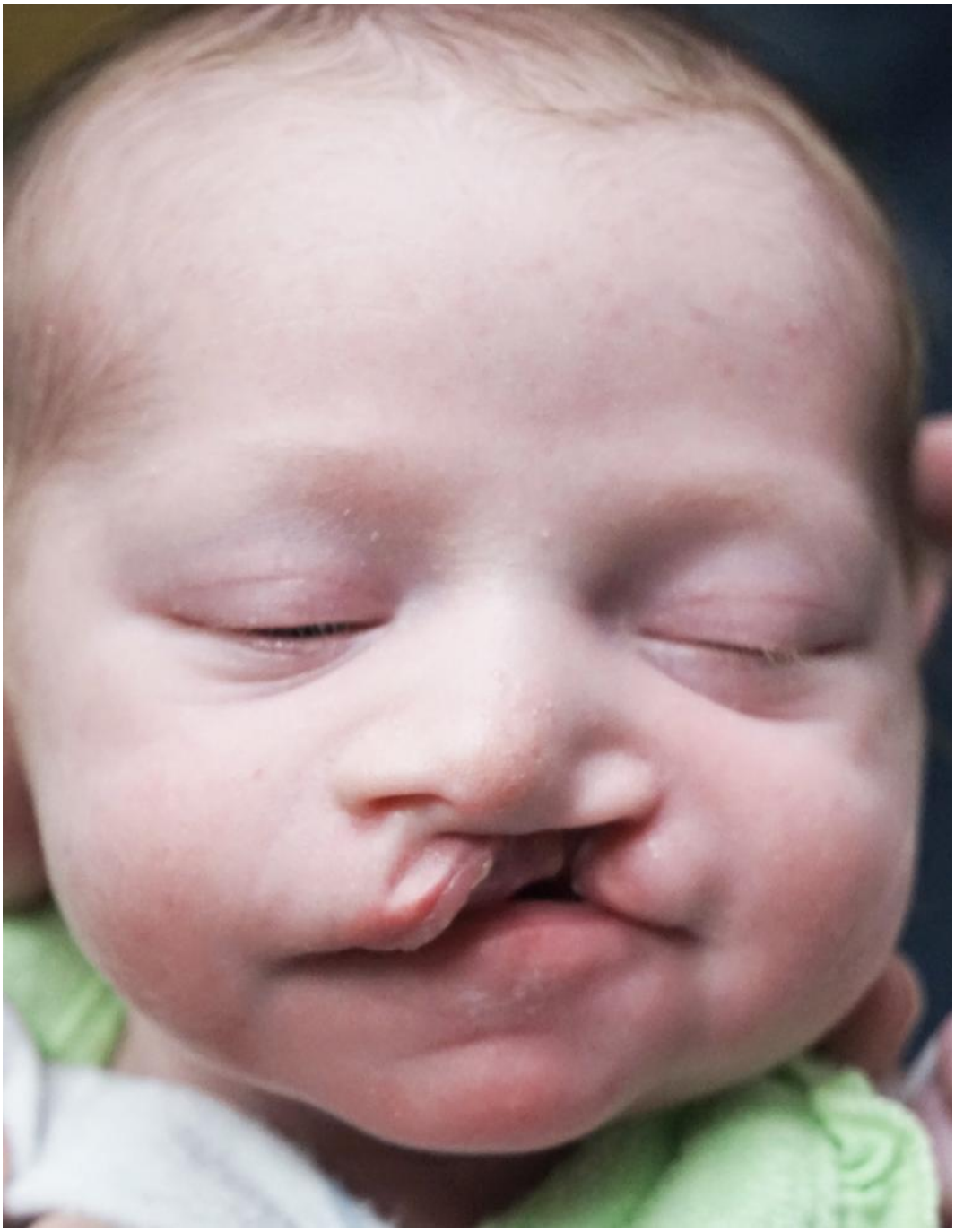
Left unilateral cleft lip:

Exercise: tracing a photograph

1. Paste the photo onto a blank canvas
2. Add a new layer on top of the photo layer
3. Trace the outline of the nose and lip onto the new layer
4. Click on the layer with the photo and remove it by clicking on the box the with check mark
5. If you want to see the photo again, click the box to make it reappear

Right unilateral cleft lip:

Left unilateral cleft lip:



Bilateral cleft lip (incomplete):

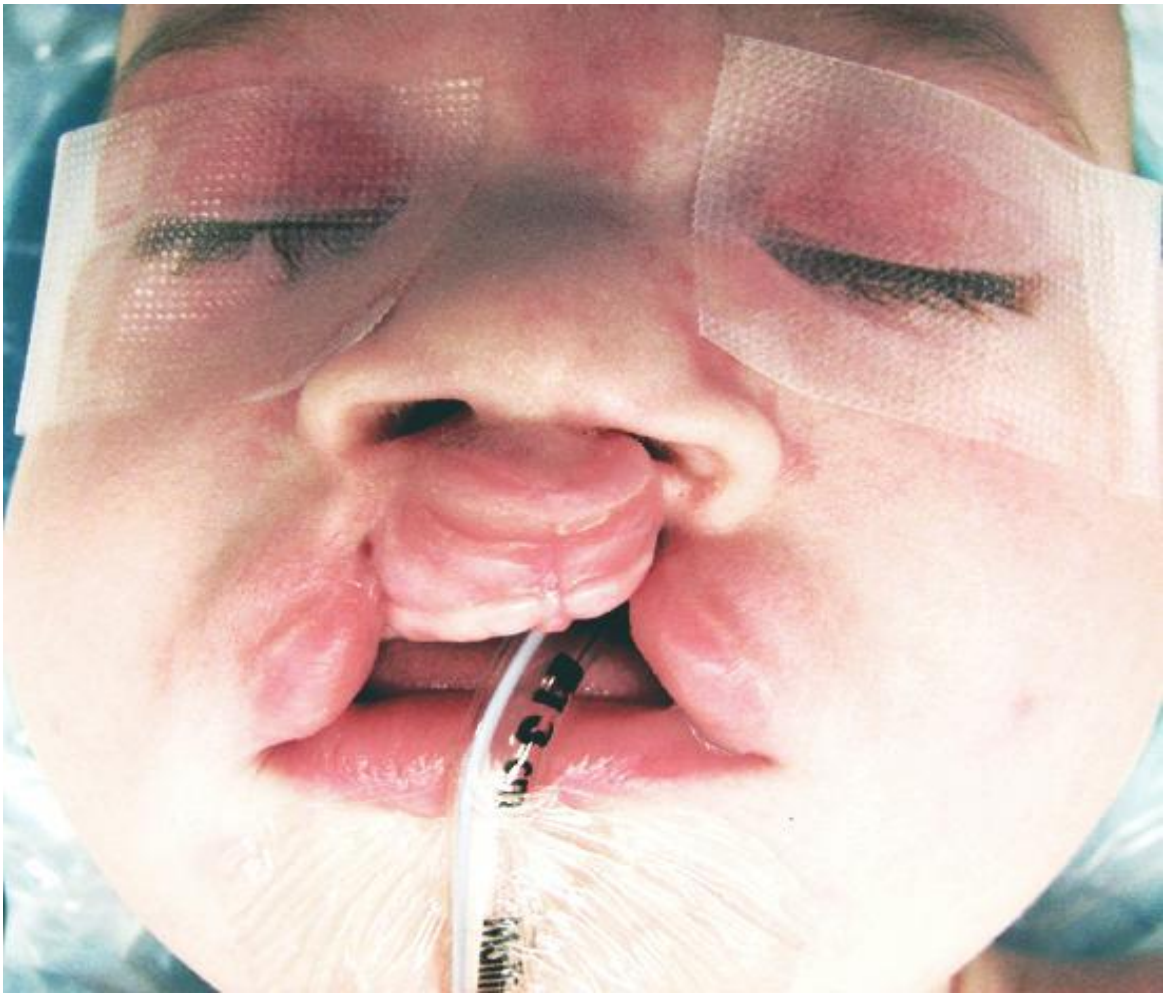
Bilateral (incomplete)

Bilateral cleft lip (complete)

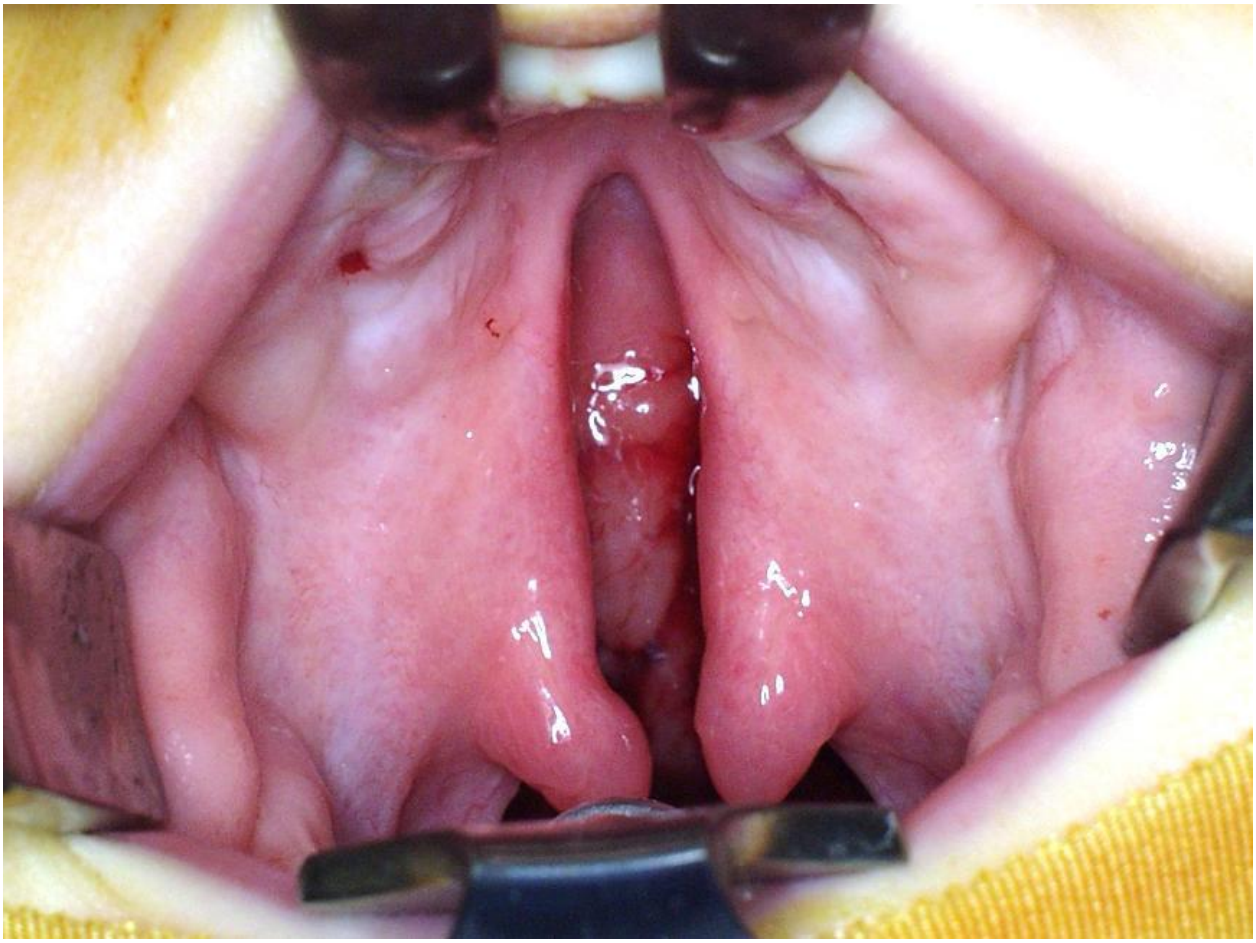
Bilateral cleft lip (complete)

Bilateral cleft lip (complete)

Bilateral cleft lip (complete and incomplete)



Veau II cleft palate:

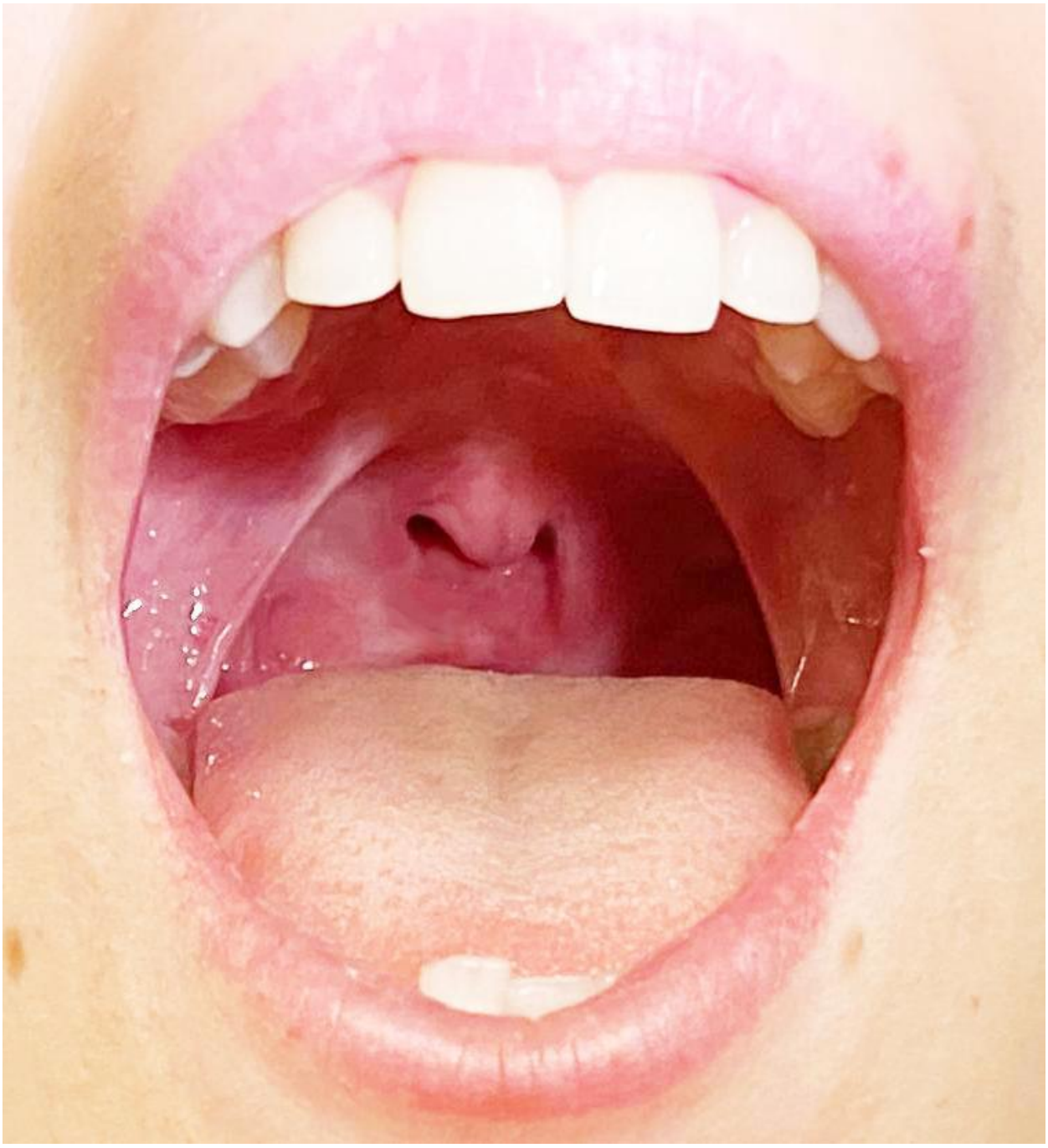


Veau II cleft palate revised to show the entire palate and alveolus.

Submucosal cleft palate:

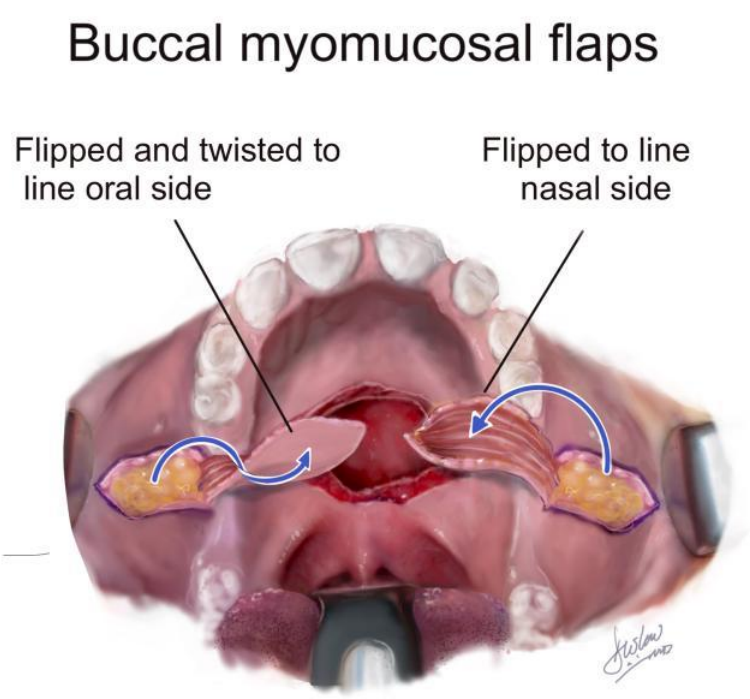
Submucosal cleft palate (zona pellucida)

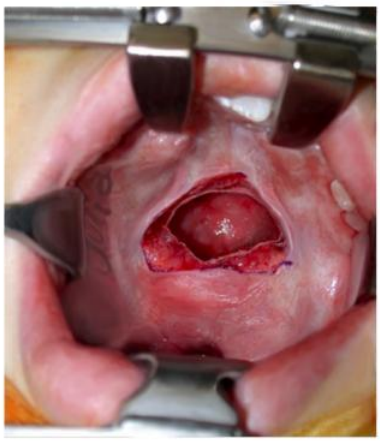
Post op sphincter pharyngoplasty



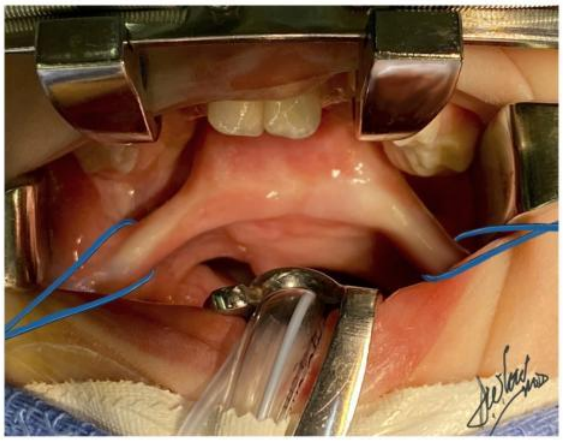
Example of hard palatal fistulas

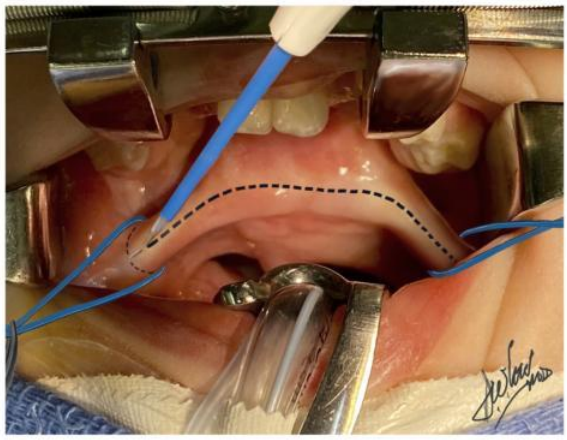
Bilateral buccal myomucosal flaps for palatal lengthening

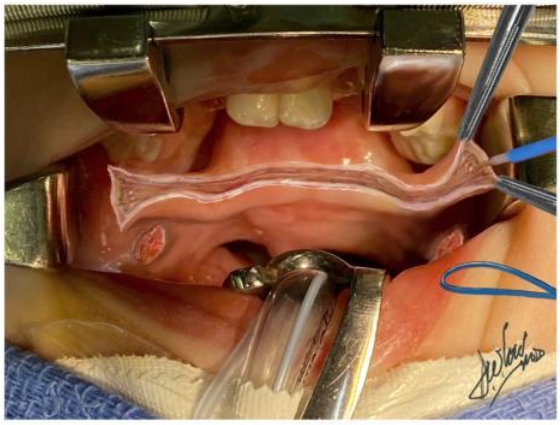


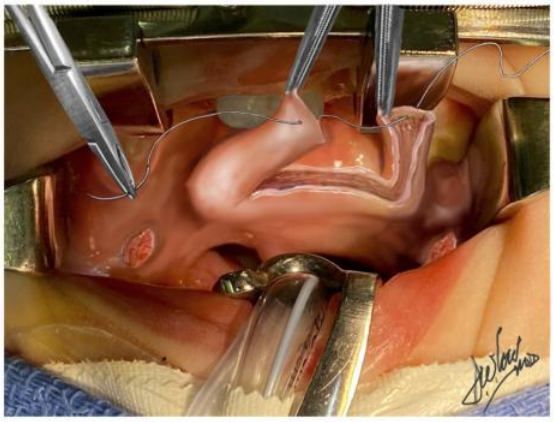


Buccal flap pedicle division and insetting

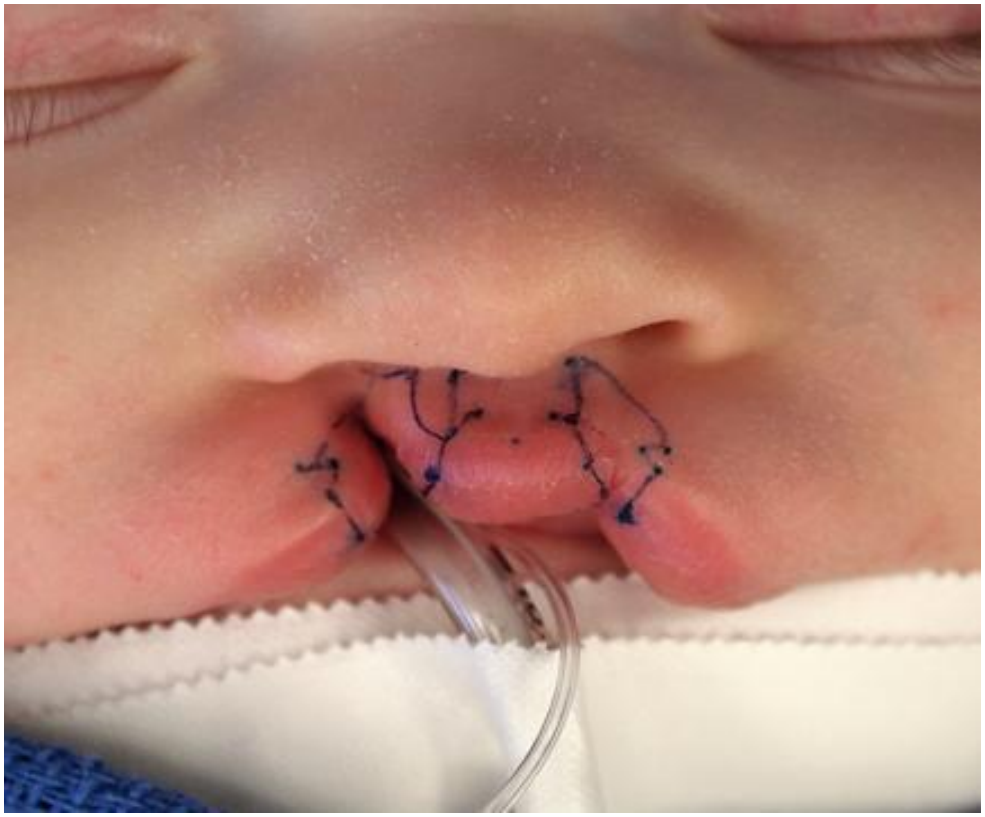




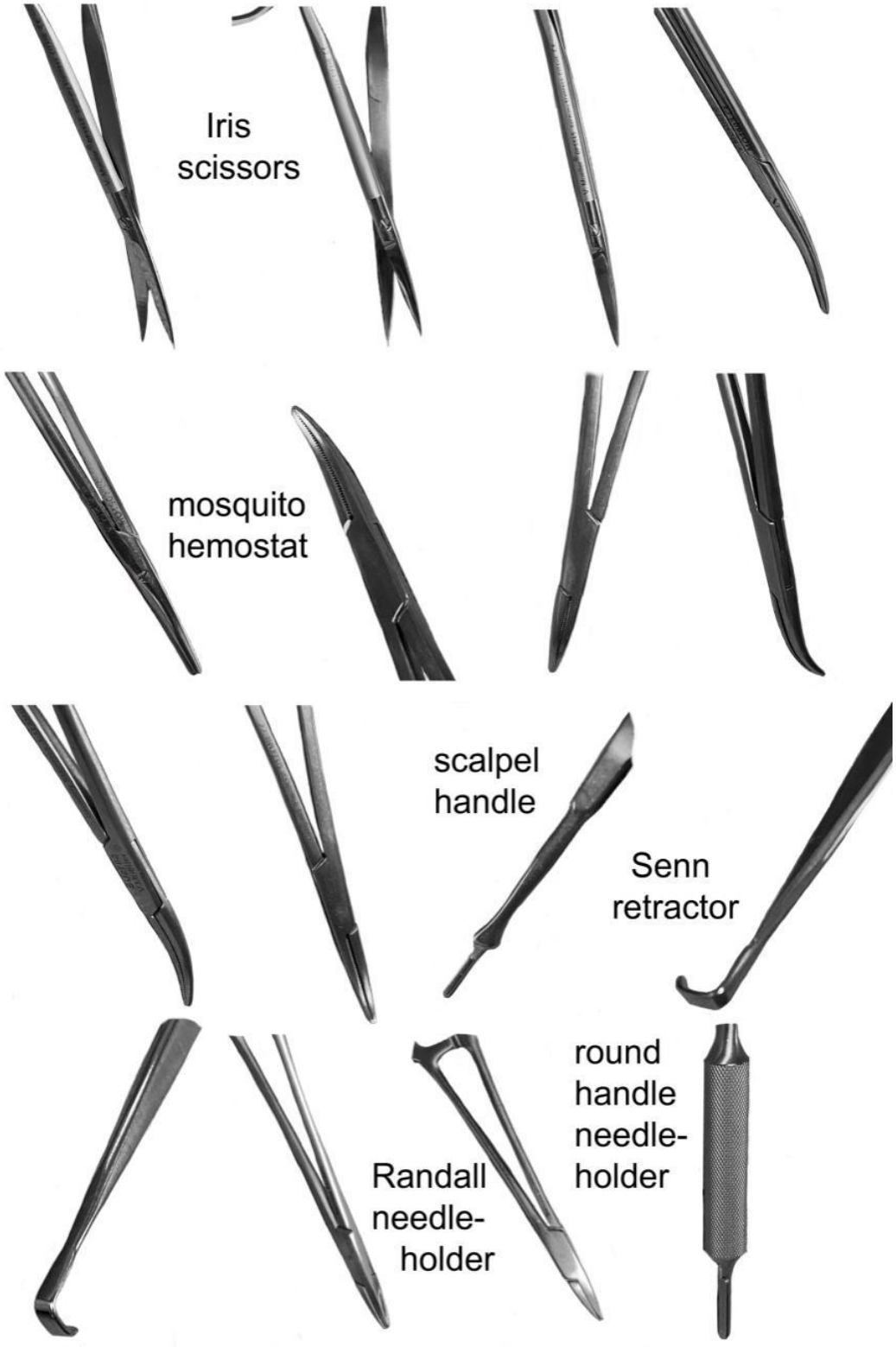




Exercise – Right incomplete cleft lip and left microform cleft lip – make your own surgical marking using a purple brush, or clean up the surgical marking using the smudge tool, the soft brush or the clone tool



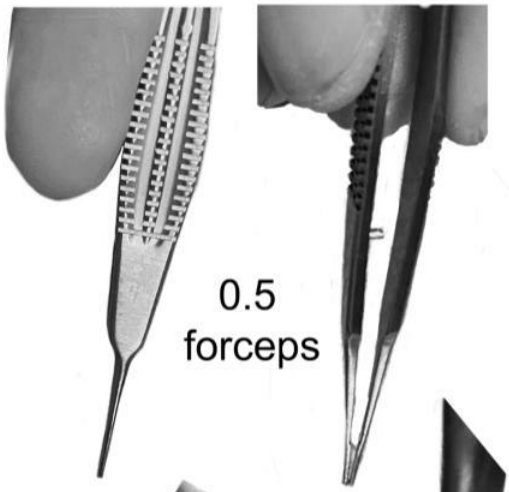
Surgical instruments for cleft surgery



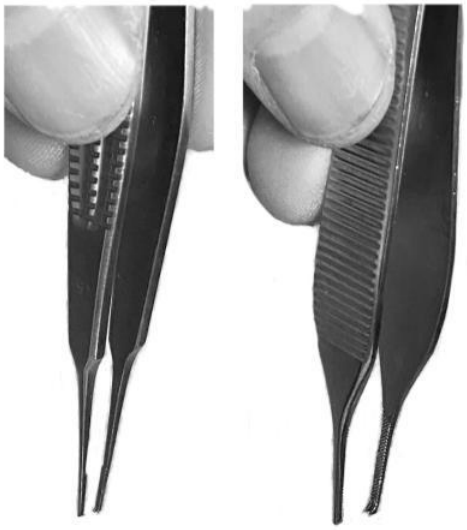
single hook

Iris scissors

Webster needle-holder

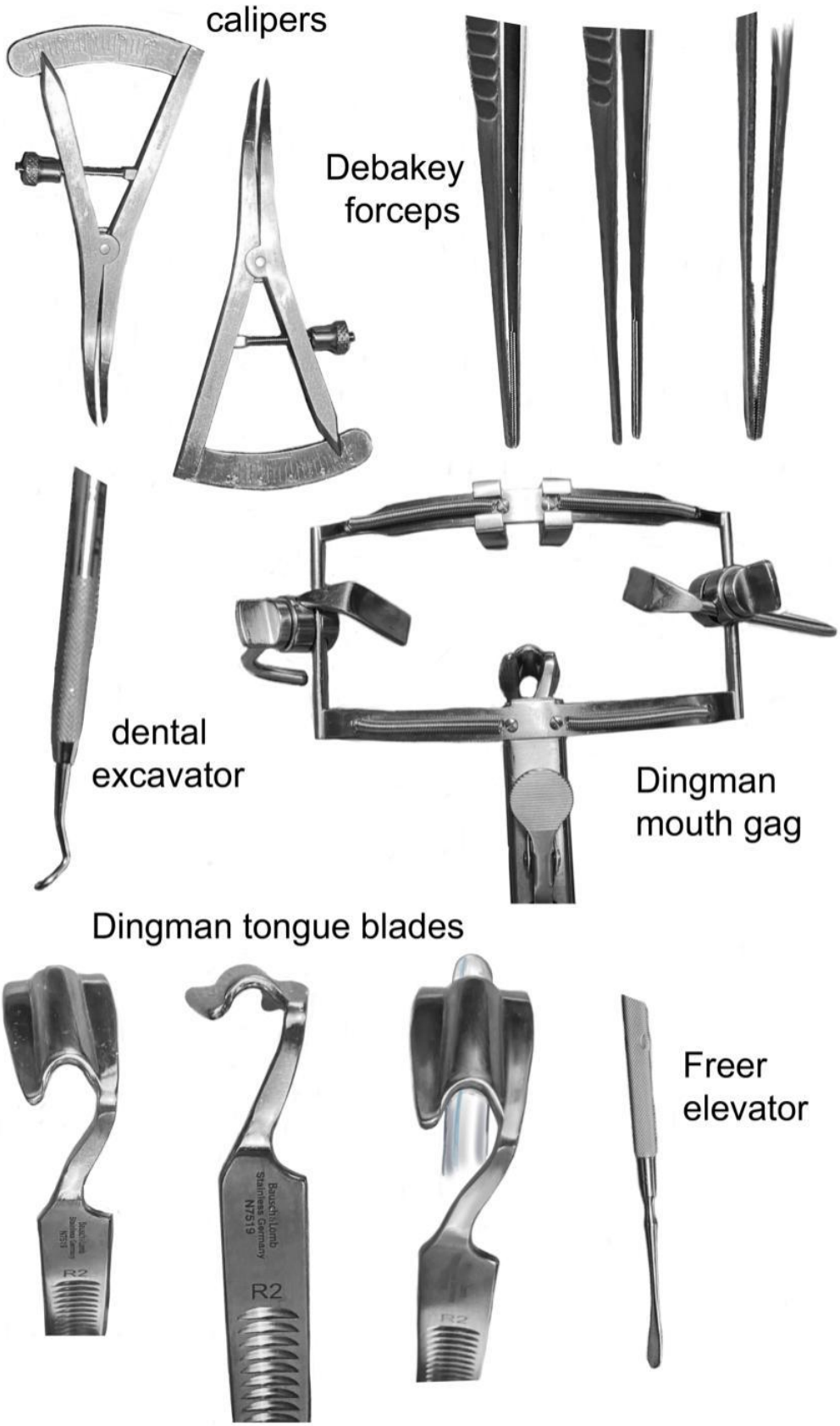


0.5 forceps



Adson forceps

Blair palatal elevator


calipers
Debakey forceps
dental excavator
Dingman mouth gag
Dingman tongue blades
Freer elevator
R2
R2
R2

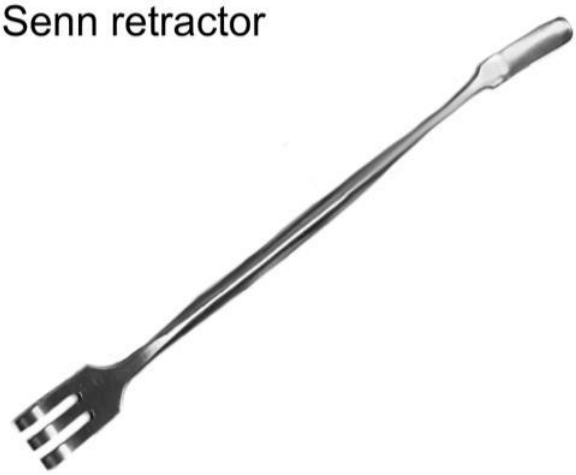
Army - Navy retractor

Obwegeser elevator

Ragnall retractor

scalpel handle

Senn retractor



dental excavator

Randall needleholder

#15 scalpel blade

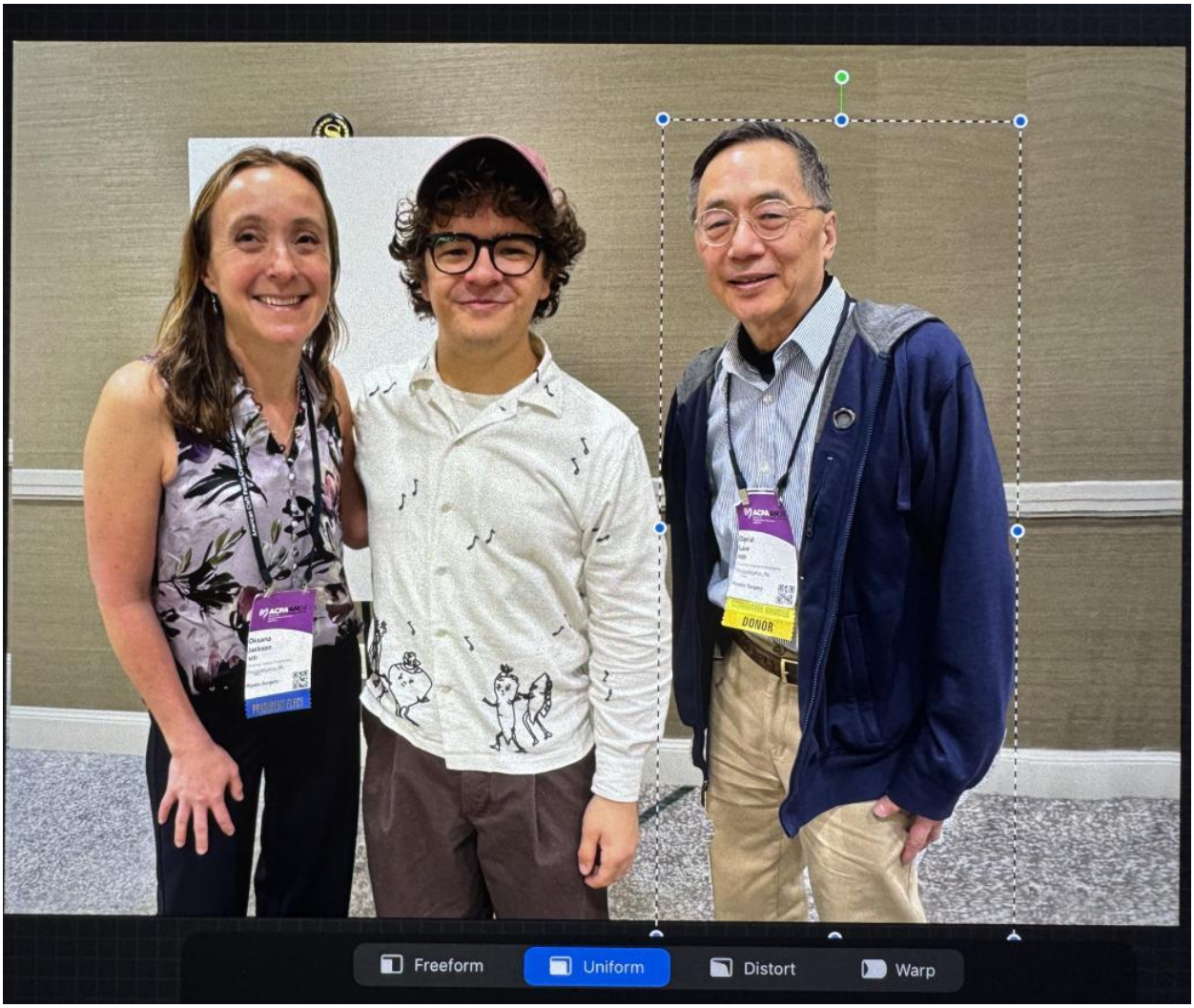
Cottle elevator

Touching up your photos – adding a missing person

1. Choose a desirable group photo (ACPA president-elect Dr. Oksana Jackson with her guest Gaten Matarazzo, star of Stranger Things, who also happens to have cleidocranial dysplasia. He spoke to the audience about his experience with this condition at the ACPA annual meeting in Denver in April 2024)

2. Find a photo of the missing person you would like to add to this photo – Choose the selection tool, click "freehand", and carefully outline the missing person

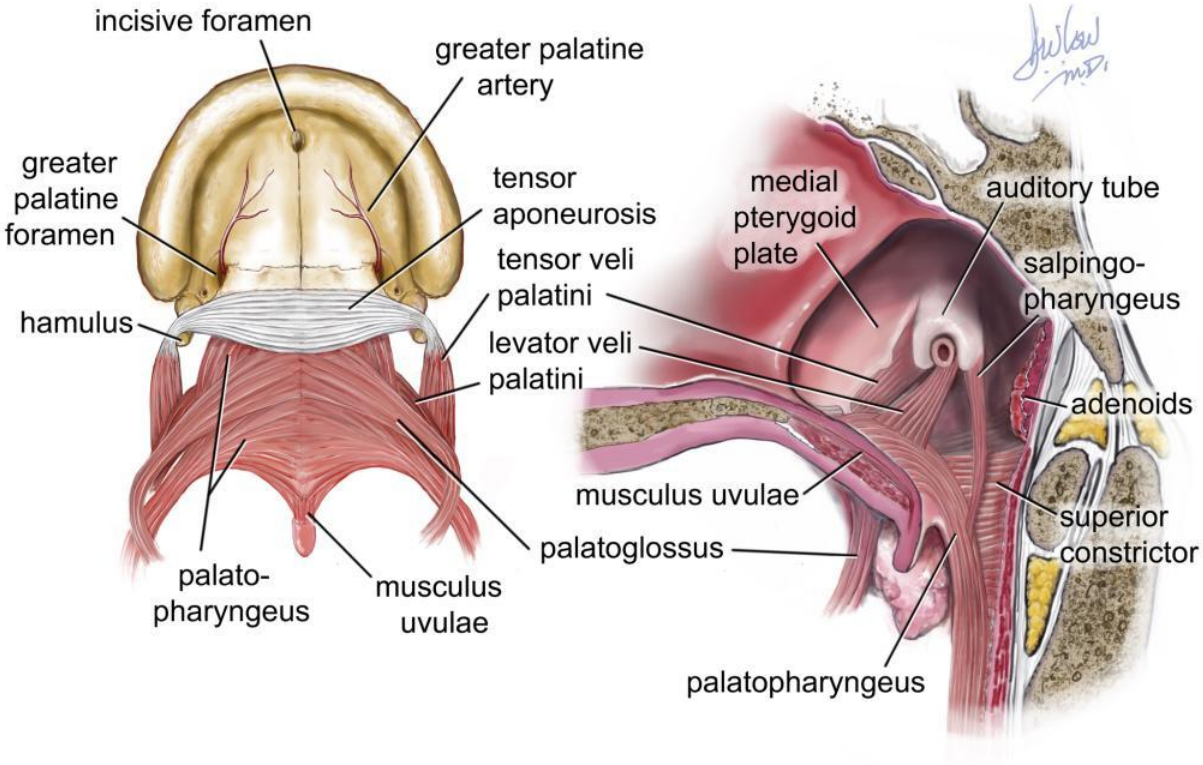
3. Click on the wrench tool, click “copy”
4. Click on the group photo, click the wrench tool, and click “paste”
5. Adjust position, size, rotation to place the missing person in the group. You may have to adjust lighting and color so it matches the group photo seamlessly.
6. You can erase parts of the person if they are behind someone else because the pasted person is on a new level. You can merge levels after you are happy with your work

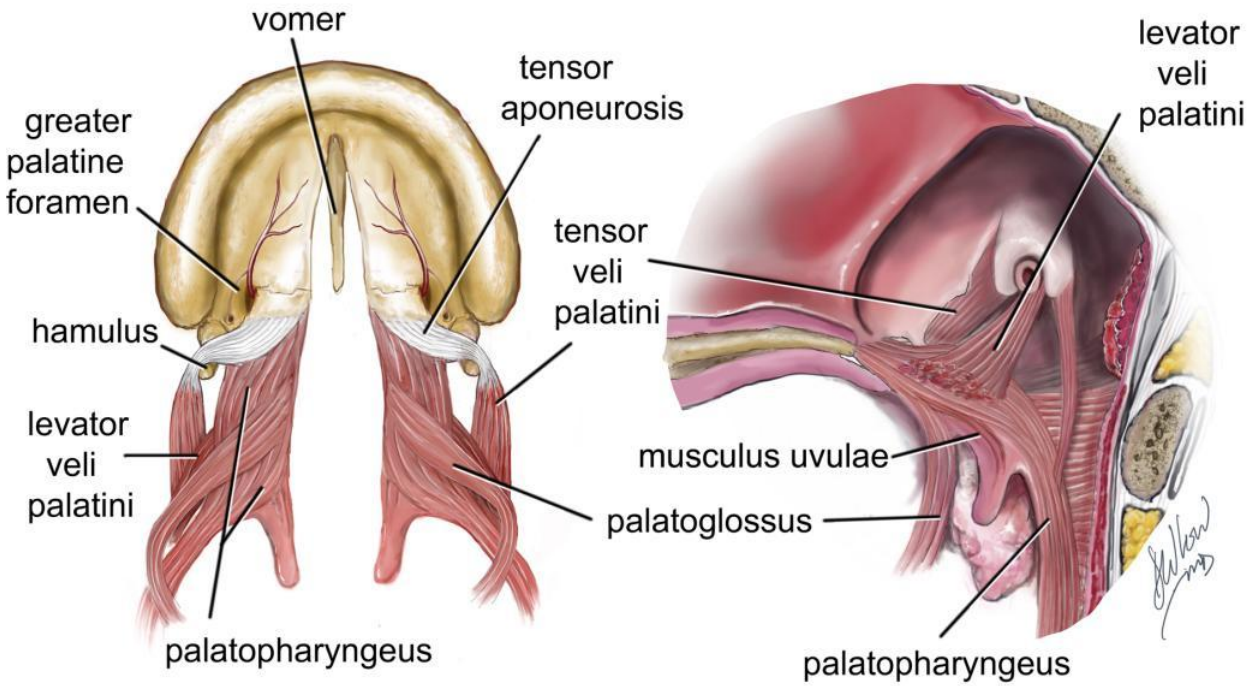


7. With these tools, you can also clone or paste open eyes on people with closed eyes, remove undesirable people, remove background objects, place people in completely different backgrounds, add famous people so you look important, etc.

In the group photo below, my eyes are closed. Trace around my glasses in the photo with my open eyes, copy, paste it onto the group photo, resize, reposition.

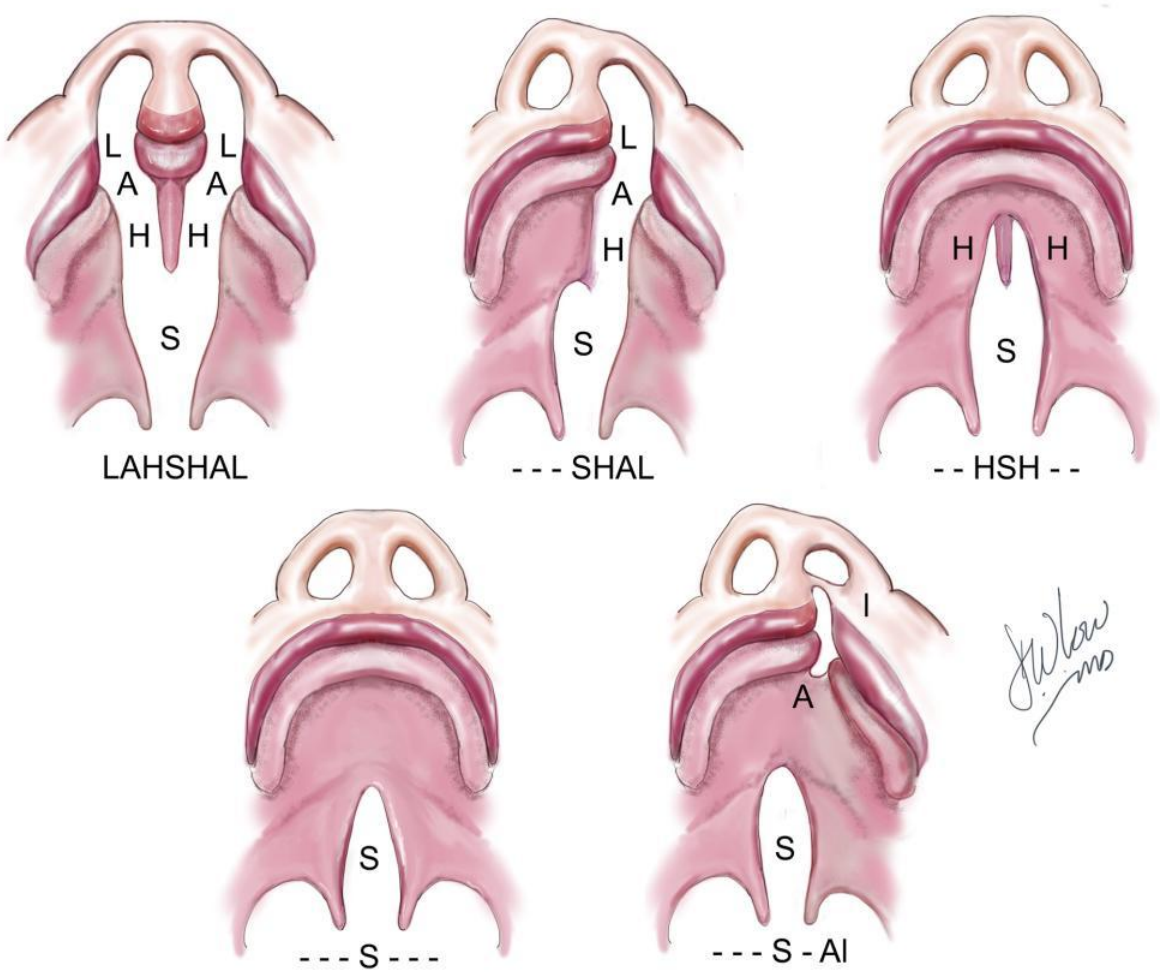
In the photo with the red eye retina reflection, use a black color to color the red reflex. You can add a white light reflection as well

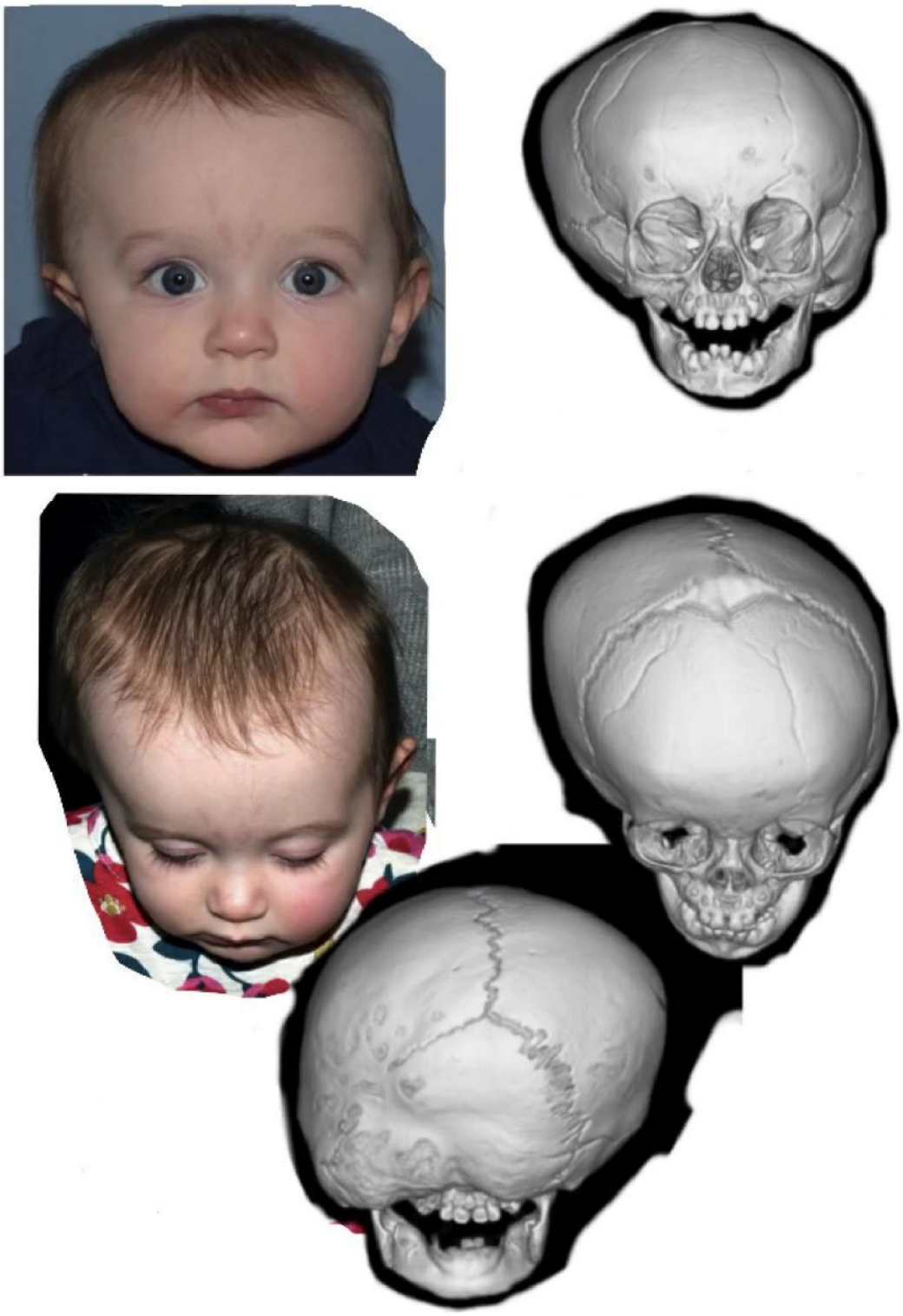
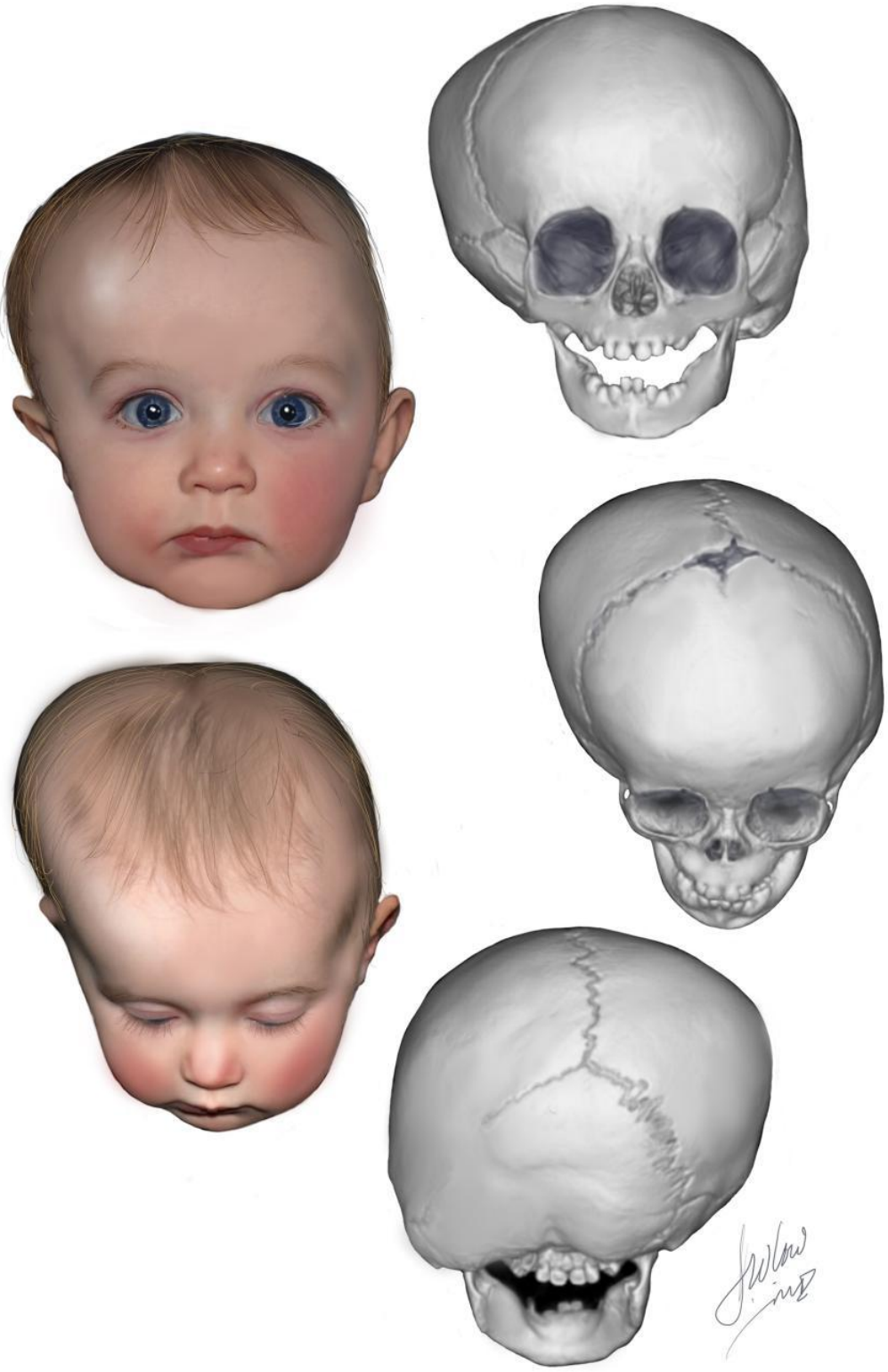

incisive foramen
greater palatine artery
greater palatine foramen
tensor aponeurosis
tensor veli palatini
hamulus
levator veli palatini
palato-pharyngeus
musculus uvulae
medial pterygoid plate
auditory tube
salpingo-pharyngeus
adenoids
musculus uvulae
palatoglossus
superior constrictor
palatopharyngeus


vomer
tensor aponeurosis
greater palatine foramen
hamulus
levator veli palatini
palatopharyngeus
levator veli palatini
tensor veli palatini
musculus uvulae
palatoglossus
palatopharyngeus

LAHSHAL (Kriens) classification of cleft lip and palate:

(capital letter = complete cleft, lower case letter = incomplete cleft, no letter = no cleft)



Challenging exercise (Final exam)

– using all your Procreate tools, refine, cut, paste, and rearrange these photos and scans into a cohesive illustration