A simple method to animate suture techniques

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Background

A variety of visual resources exist to illustrate suture techniques in dermatologic surgery, but most of these resources consist of static graphics and images. While a series of illustrations may be helpful to conceptualize techniques, the true motions and movements that are essential to correctly implementing them are not always adequately represented. Animations may solve this problem, but they are often made by animators with no medical or surgical experience and therefore may lack the subtleties to correctly understand the technique. We present a method that is both simple and efficient to create a variety of suture animations, thereby allowing surgeons, fellows, residents, and students with minimal to no animation experience to easily animate desired techniques for learning purposes. While these methods may be expanded to other areas of dermatologic surgery, we focus only on suturing techniques.

Methods

### Visual conceptual description of technique

See *Figure 1*.

Written description of technique

Simple animations of suture techniques were developed using Adobe Animate CC. This program was chosen as the platform for animation due to its ease of use, widespread availability, and relatively low cost (academic discounts available). The animations were created with a step-wise and layered approach (1). Layers of the skin and the final

suture path were created first. This was followed by the final suture path being incrementally stepped backwards. The final step was to simply reverse the frames to create a finished animation.

To demonstrate this animation technique, a step-by-step sequence of how to create a vertical mattress suture animation is described below, but virtually any suture technique may be animated in a similar fashion (2,3).

(I) To begin, create a new project in Adobe Animate by selecting "File" → "New". *Figure 2* shows the workspace layout. The "stage" is where the skin background as well as the suture elements will be drawn. The "timeline" at the bottom shows how various elements or layers change at different points in time, also known as frames. Present on the right side is "properties" section, which allows you to adjust properties such as frames per second (this determines the speed of animation) and height and width of the stage.

(II) Next, create the "skin background" layer using the following steps. First save a skin template to your desktop. This skin template can be created by you using the various tools available (e.g., brush tool or rectangle tool) or can be created using images found online. Next select "Insert" → "Timeline" → "Layer" to make a new layer. Following this, select "File" → "Import" → "Import to stage" and choose the image of the skin template to bring it onto the stage. We show our example of the skin background layer in *Figure 2*.

(III) Next, create a new layer (see step II) with the image of the final suture path, which we call "suture path"

A

B

C

D
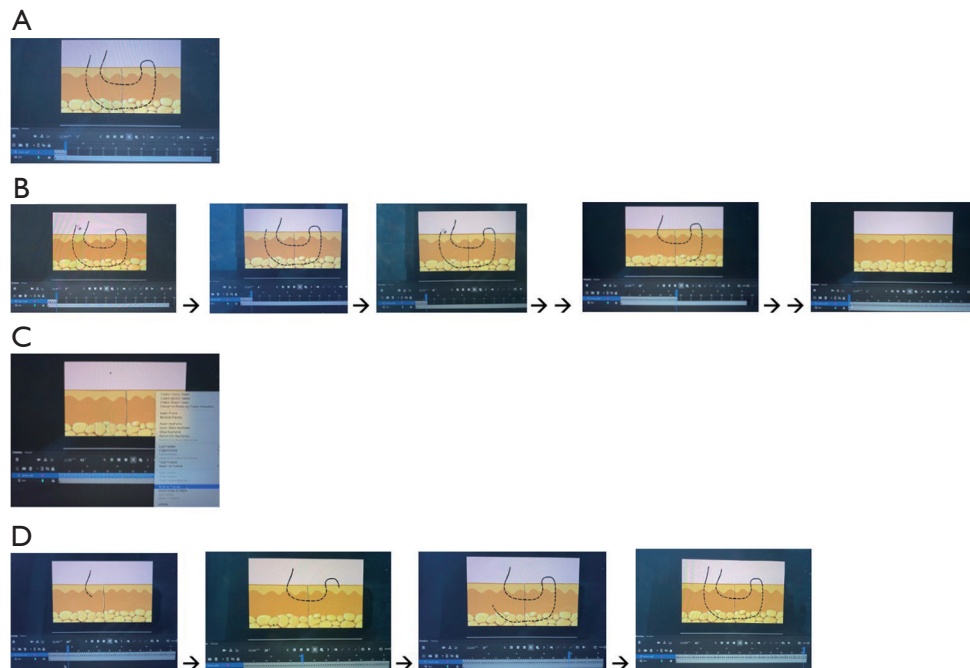
Figure 1 A step-by-step explanation of how to animate a vertical mattress suture path. (A) Draw your final suture path using paintbrush tool. (B) Create a new keyframe and erase a small portion of the suture using the eraser tool. Repeat this process until the suture is completely removed. (C) Select the keyframes on "suture path", right click on them, then choose reverse frames. (D) Now, as you advance forward, it appears as though the suture line is being drawn.
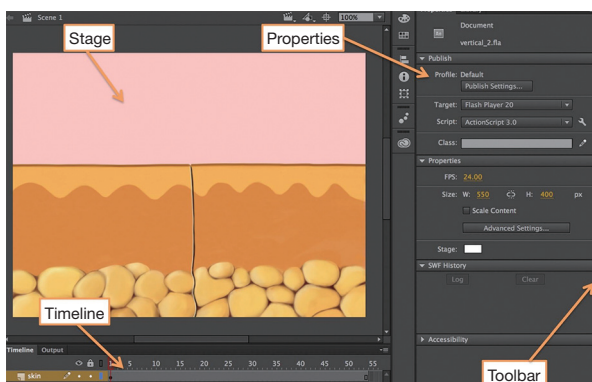

Figure 2 Screenshot of Adobe Animate CC workspace with skin background layer. Important elements of the workspace are labeled.

layer. Using our classic paintbrush tool, we draw out the final suture path (*Figure 1A*).

(IV) The next step is to begin animating. Create a copy of the final suture path on the layer "suture path" by creating a new keyframe, which is a frame that will have a new symbol. To do so, select "Insert" → "Timeline" → "Keyframe", which will create an exact copy of the suture path in the next frame. Once this is created, use the eraser tool to remove a small portion of the end of the suture path. Create a new keyframe based on this partially deleted suture path and erase another small segment. Continue to follow this step with making keyframes and removing portions of the suture until the entire suture path is removed (*Figure 1B*).

(V) Once this is finished, select the "suture path" layer, right click on the keyframes, and select option "reverse frames", which will reverse the order of the frames (*Figure 1C*). This will lead to the first frame being the completely erased suture path and the last frame being the completed suture path. Intervening frames will be the small segments of sutures that were initially erased, but when reversed, appear to be added from the erased suture path to become the final one (*Figure 1D*). An alternative option to animating a suture path is to use the "shape tween" feature, which will animate one shape at a particular frame gradually morphing into another shape
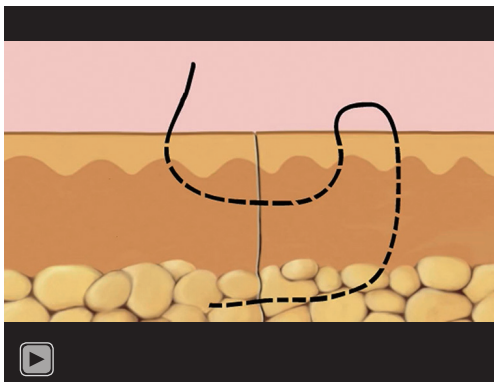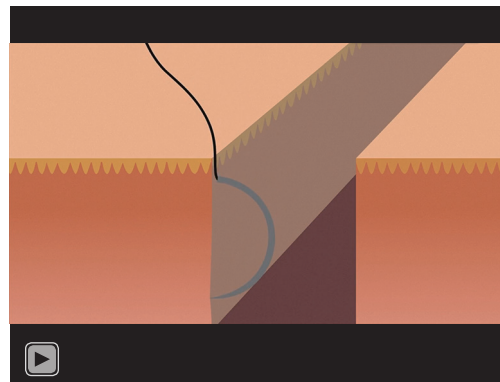
Video 1 A vertical mattress suture animation.
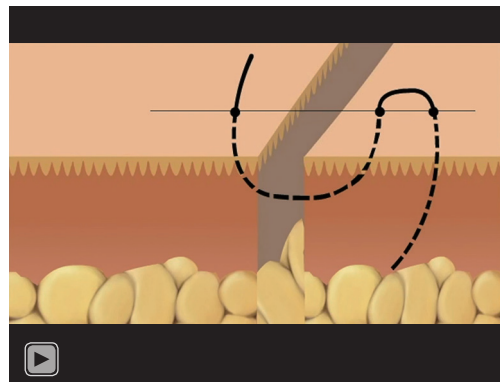
Video 3 A vertical mattress *vs.* horizontal mattress animation.
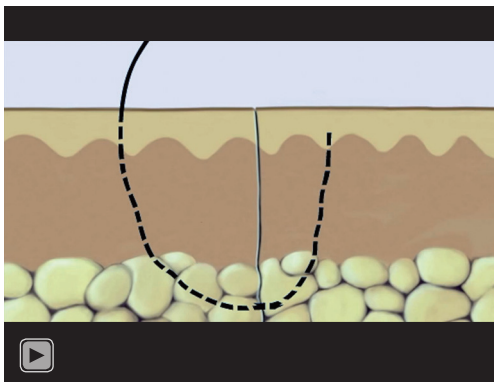
Video 2 A pulley stitch *vs.* vertical mattress animation.

Video 4 A deep dermal suture *vs.* buried vertical mattress suture animation.

at another specific frame, though this method is slightly more complex to use (4,5).

(VI) Next, click play to see the animation in action.

(VII) Once the animation is complete, you can export the animation to another format such as mp4, by going to "File" → "Export", and then selecting the type of file that you desire. See *Video 1*, which demonstrates an example of the vertical mattress animation. We have also created suture animations for other techniques which may be confused by early residents. Please see *Video 2* for pulley stitch *vs.* vertical mattress animation comparison. Please see *Video 3* for vertical mattress *vs.* horizontal mattress comparison. Please see *Video 4* for deep dermal suture *vs.* buried vertical mattress suture comparison (tweening method).

Conclusions

While animation is a more effective medium to convey techniques in dermatologic surgery, it is often underutilized due to its perceived level of difficulty. The method we present is an effective way for individuals who have little to no animation experience to create animations of suture techniques. This will allow medical professionals to create animations for teaching, lectures and presentations, and other purposes. In addition, residents do find these animations quite helpful and a group of seven surveyed first-year residents from two dermatology programs reported that these suture animations helped them to "better understand these suture techniques" and helped them to "understand suture techniques better than static images in a textbook".

Footnote

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Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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