

# Kobra Manual



**Forsslund Systems**

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## *Introduction*

Welcome to the Forsslund Systems surgical simulator community! We are proud that you have given us the opportunity to produce this simulator and show how it can be useful to your institution.

The slogan of our company is “freedom to operate”, which is a play on words. Operate in its meaning of doing surgery, and teaching thereof using the latest technology, is a tradition in our founders family. My grandfather Gösta Forsslund was the first maxillofacial surgeon in Sweden, and taught surgical extraction of wisdom teeth using hammer and chisel. This was the most sanity clean way in the 1950s. My father Hans Forsslund taught dentists in rural areas on Gotland, Sweden to be confident to do minor surgery themselves instead of referring everything to his specialist role at the county hospital. At all times it have been pig models, live patients or audio-visual presentations that have been the instruments for training. What you have purchased is our contribution to changing that to risk-free hands-on training on a variety of *virtual* patients.

The other meaning of “freedom to operate” refers to the freedom to use and manipulate the simulator as you wish. Most, if not all, surgery simulators today are locked down. In comparison we try to keep as much technology as possible *open* insofar we can sustain our business. We believe that collaboration will help improve all simulators from which we all will benefit. That is why the core technology of our simulations is open source, shared and improved upon in technical universities on three continents. If you want to tinker with the *Kobra* simulator you are warmly welcome to the development community. See the section on open source software for details.

Jonas Forsslund, April 2016

## *Support*

If you need further assistance, please email: [support@forsslundsystems.se](mailto:support@forsslundsystems.se). This manual is continuously under development, and we appreciate feedback that can help improve it.

# Names and Acronyms

3D Display	The mirrored display where the user looks during operation
3D Glasses	The battery-driven glasses enables 3D vision
Case	A patient case, or an artificial exercise
Web Front	The Internet-based store of patient cases and recorded sessions, sometimes known as “fs-wisdom”. <a href="http://fs-wisdom.appspot.com/">http://fs-wisdom.appspot.com/</a>
Haptic device	An advanced joystick that gives force feedback in three dimensions
Haptic feedback	Feedback from a computer to a human’s haptic sense of touch
Kobra	The white physical simulator you are using
Mannequin	The rubber head in the Kobra, whose primary purpose is hand support
My pages	Individual results and list of sessions for a particular user
Pad	The small screen is used as a control panel to run the 3D Display
Session	A user’s recorded carving path and statistics of material removed
GUI	Graphical User Interface

## Using Kobra

In this chapter we describe how *Kobra* is used.

### Operating the machine

*Kobra* has two screens: one mirrored *3D display* and one control *pad*. You start *Kobra* by pressing the big button on the front of the machine. In addition you need to start the pad by pressing the button on the top and behind of the retractable *pad* case. The *pad* sits in a compartment that can be pushed in from the side for storage. Push on it to get it out.

When both the *3D display* shows a FS logo on a white background, and the *pad* shows a login screen you are ready to operate. Otherwise see *troubleshooting* below. The simulator can be turned off by pressing once on the front button and waiting a couple of seconds.

The 2016 year model of *Kobra* comes with a height-adjusted table which can be controlled using buttons on the side. Note: first time it is powered on you should calibrate it by pressing “down arrow” all the way to the bottom, release the button, then press and hold the button for 10 seconds.

### Offline Mode

The offline mode lets you use the simulator without Internet connection. The limitation is that you cannot save or replay sessions. If new cases are added the simulator software need to be updated. Continue with section “Starting and running a case”.

### Logging in

Every user of *Kobra* has to have an account with *Kobra Web Front*. Each university that owns a *Kobra* can create unlimited number of accounts (see *administration*). The purpose of the accounts is to store and replay *sessions* and provide statistics to the individual user.

Click on the login respective password input box and enter your credentials using the virtual keyboard that appears.

### **Starting and running a case**

When you have logged in you will be presented with a list of *cases* to choose from. You may click on one to read about it and see x-ray images. Click *start case*. The *pad* might show *downloading case* and *Launching case*. When the case is loaded the *3D Display* will show a 3D scene. Turn on your *3D Glasses* by pressing the button on the left side of them. A green light should turn on (and off in a few seconds), otherwise they might need to be charged, see *troubleshooting*. Looking down “through” the mirror you should now see a virtual dental drill. Hold the *haptic device* handle like a pencil, with the joint facing downwards into the *mannequin* head. See how the virtual drill moves as you move the handle.

Touch the virtual teeth with the virtual drill (there might be only a few teeth that are interactive). To be acquainted with the feeling of *haptic feedback*, try to carefully follow the surface of the virtual teeth. Move the *haptic device* handle while maintaining a little bit of pressure against the teeth. This movement is one of the haptic exploratory procedures we humans use to form a mental picture of a physical object by the sense of touch. If you have never used a *haptic device* before it is very useful to spend some time following the contours of the teeth before continuing with the case. At this time, no result is recorded since you are not drilling anything and thus you cannot “harm” the patient by just feeling.

Now, press the left foot pedal and the drill begins. Press the right foot pedal to switch to the secondary instrument such as an elevator. For instructions on how to solve each case we refer to the case description and the teacher. During the exercise you can see statistics over burred material on the *pad*.

### **Saving a session**

When working with a case you can at any time press *Save simulation* on the *pad*. It will then store the results and the recorded *session* in *FS-Wisdom*. After saving you can exit the simulation.

### **Replay of a session**

After you have logged in and before starting a case, you will see a list of previously recorded *sessions*, for each case. Click any of them to load in the simulator and you may click *play* or *pause* on the *pad* to see the case being replayed.

## *Kobra Web Front*

All cases and *sessions* are stored in the web-based *FS-Wisdom* system. This allows for multiple users and for replaying *sessions* from any *Kobra* in the world given a login and password.

### **Accessing “My Pages” of a user**

Using an ordinary computer, go to the website <http://fs-wisdom.appspot.com> and login. You will be presented a list of previous recorded *sessions* and can see their statistics, like amount of bone removed.

### **Administrating users**

Using an ordinary computer, go to the website <http://fs-wisdom.appspot.com/admin> and enter the admin password. Here you can add and remove users to the system.

# Troubleshooting

## **You see a double picture or 3D glasses does not turn green when button is pressed**

Check the *3D Glasses*, they might need charging.

## **The image of the virtual drill does not coincident with the haptic device**

The *haptic device* might need to be *calibrated*.

## **The pad is not showing the login screen**

The interface to the *Kobra* is run within a web browser on the *pad*. Please close and start the web browser again. It should start in the login screen as home page.

# Calibration (for technicians)

Sometimes the *haptic device* needs calibration. Especially if the device have been physically moved or unplugged since last time it was used. To do this you need to have access to the locked compartment of the simulator. Unlock the top back door and take out the wireless keyboard (with trackpad) you find there. Turn the keyboard switch on at the flip side of the keyboard.

1. When the simulator shows the FS logo on a white background, hit *escape* and you will get into the administration mode.
2. Click on the *Calibration step 1* button
3. In the GUI that appears click Apply. This resets the *haptic device* and prepares for new calibration. Click Ok. Note: the device is called Phantom Desktop.
4. The lamp on the device should now blink green or steady yellow
5. Click on the *Calibration step 2* button.
6. A terminal based program appears and says *Calibration requires manual input...* every second.
7. Move *haptic device* to its limits, left, right, in, out, up down. Until it stop saying calibration routine... and starts saying *Device position: ...* (three coordinates).
8. Hit escape
9. Lamp should now be yellow-ish.
10. That should be it. Click the button "Back to Fullscreen Logo". Put the keyboard back and lock.
11. Note: if you see any disturbing window or menu bar after this step, just power off and then power on the simulator using the physical start button on the front.

# Cleaning instructions

The body of the simulator is made of wood and can be cleaned like any furniture using a dry or dampened cloth. The mirror and the monitor glass should however be handled with care.

The mirror is a so called front-surface mirror which means it only has a very thin protective coating before the reflective surface. This is to avoid double reflection of ordinary mirrors. Clean the mirror gently using a selvyth cloth and, if needed, acetone.

The monitor glass is in fact a glass laminated half-wave retarder, a kind of polarizing filter, and can like the mirror be cleaned with acetone. If there is just dust it can be removed with a clean soft brush, e.g. a make-up brush.

## *Software Update (for technicians)*

The Kobra simulation software can be updated through the administration GUI. Unlock the top back door and take out the wireless keyboard (with trackpad) you find there. Turn the keyboard switch on at the flip side of the keyboard.

1. When the simulator shows the FS logo on a white background, hit *escape* and you will get into the administration mode.
2. Click on the *Update Kobra Software* button. The simulator will reboot after installation.

## *Technical details and components*

3D Glasses	Two pairs of glasses per simulator (Nvidia 3D Vision 2)
Foot Pedal	One set of pedals with 2 side buttons and 1 central button
Mannequin*	One silicone mannequin and holder box per simulator
Haptic Device**	Sensable Phantom Desktop (3D Systems Touch X)
Haptic Device box	Original packaging box for the <i>haptic device</i> . Please Keep!
Wireless keyboard	A wireless keyboard with built in mouse for administration
Height-adjustable table	A custom-made height-adjustable table based on Swedstyle.
Keys	A set of keys for the doors and mirror
Dimensions without legs	62 x 67 x 115 cm (WxDxH) (+ 32 cm width for pad)

\*) Note: The silicone *mannequin* is handmade and designed to be durable. However, it tears easily so avoid using sharp instruments. It can be cleaned with normal cleaning and disinfection chemicals.

\*\*\*) Note: The *haptic device* is a very expensive and delicate component of the simulator. Please handle it with care and remove it from the simulator and store it in its original box during any transportation.

## *Notes on open source software*

The core simulation software running on the *Kobra* simulator is *forssim*, an open source project maintained by Forsslund Systems AB. You may download source code from <http://dev.forsslundsystems.se> and use it under the terms of the GNU General Public Licence. This license is the most common of the *free and open source software* licences and permits use, modification and sharing as long as the code remains open. If you would like to use the code for proprietary projects please contact Forsslund Systems for other terms. If you are a developer and want to experiment, we would be happy to hear from you. Email [support@forsslundsystems.se](mailto:support@forsslundsystems.se).



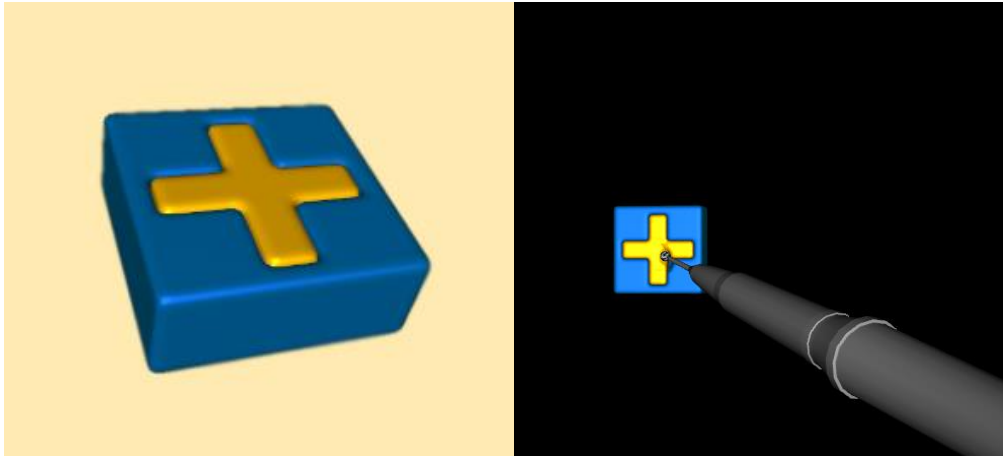
# *Installed Cases*

As per 2016-04-29

1. Crossbox
2. Mesioangular retinated third molar
3. Impacted d23
4. Extraction d36
5. Impacted d85
6. Apicoectomy d22



# 1. CrossBox



The purpose of this exercise is to remove the yellow cross without harming the blue background. The goal for you is to get acquainted with the simulator and how the drill behaves, as well as practice steady handling of a dental drill. The blue material is hard representing enamel and yellow represents dentin. This can be used to guide the drill moving close to the wall.

## 2. Mesioangular retinated third molar

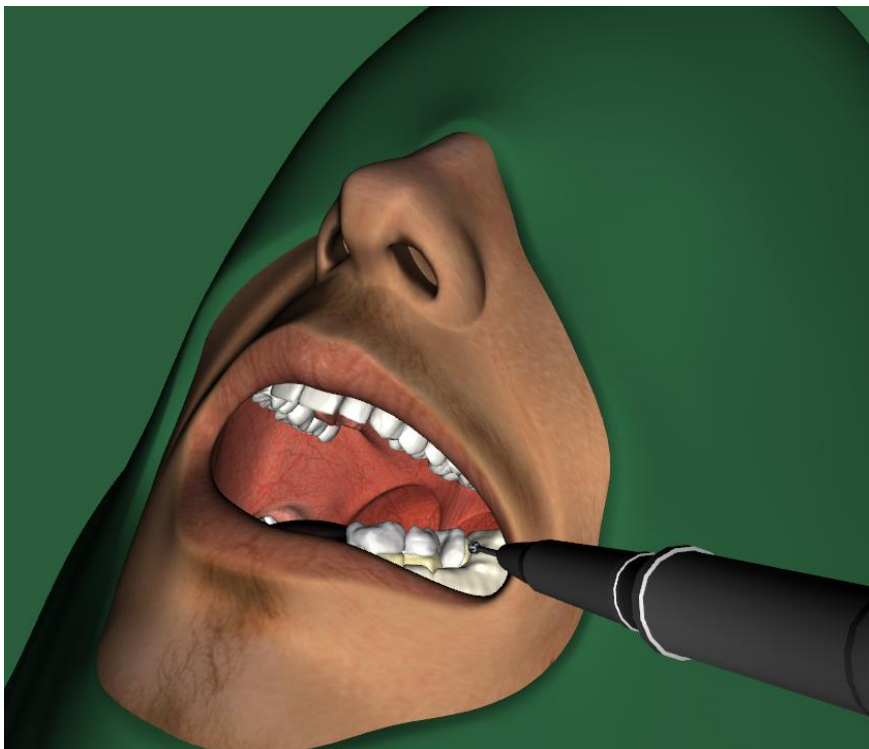


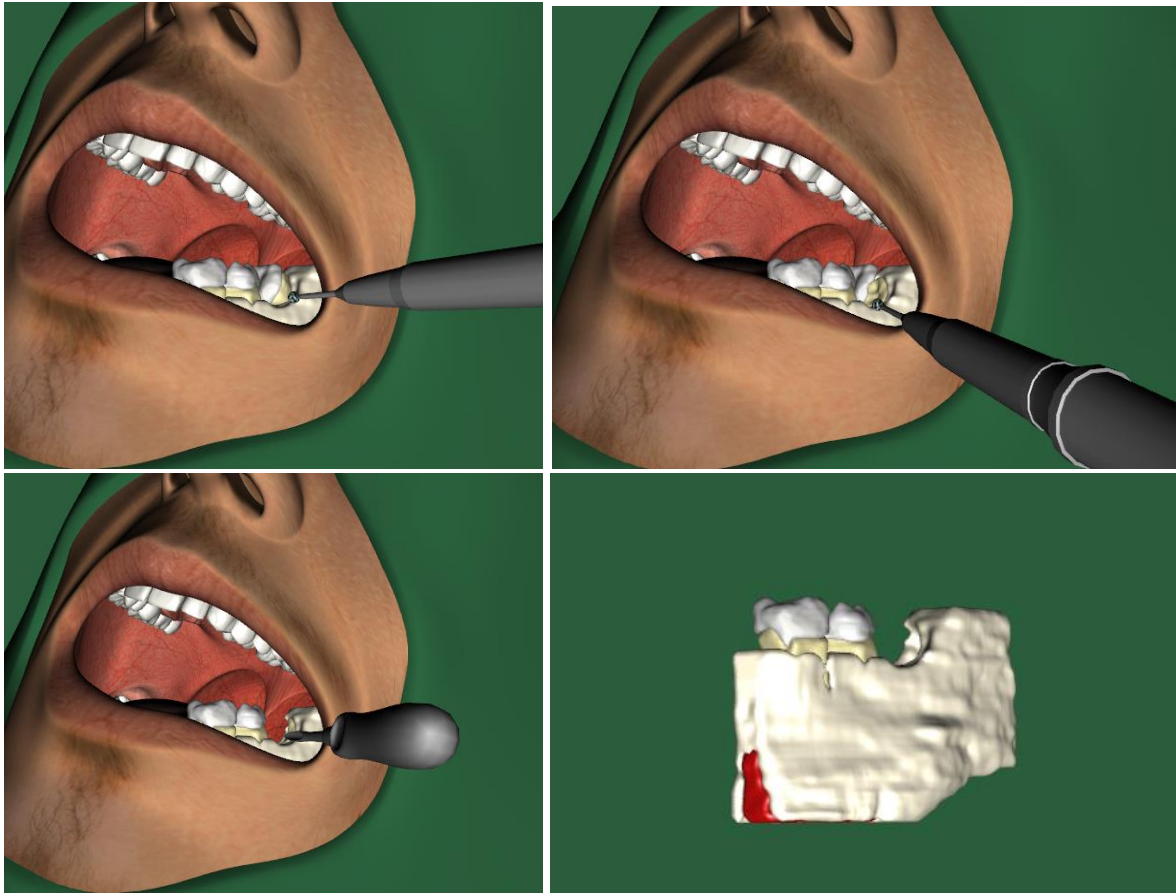
### Patient

Alban Root is a 28 year old male who requires a surgical extraction of his third molar.

### Treatment plan

The goal of this exercise is to fully remove the third molar in a safe way. Take a look at the x-ray image and plan accordingly.

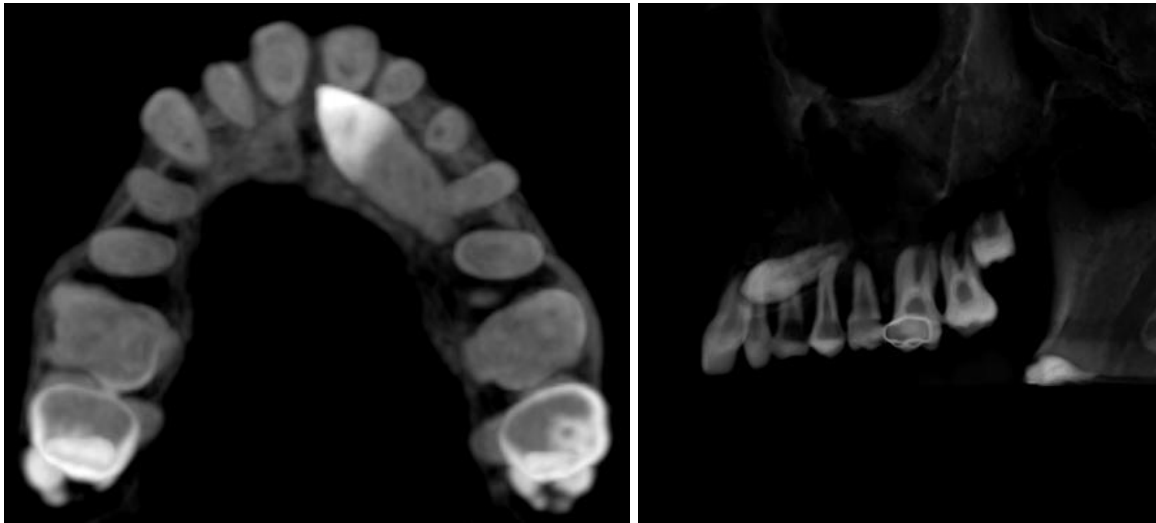




### **Suggested solution**

Remove some bone to get better access. You may try to pry the tooth loose with the elevator (press right pedal) but the crown need to be removed to get the tooth out. Section the tooth in the enamel-dentin border about 2/3 through the tooth. Apply the elevator, and if you have drilled enough the crown will come out. Now try pry out the root with the elevator, you might need to remove some additional bone to get it out. When completed you can inspect the result by hiding the face (using the pad). Tip: rotate the model to inspect from the lingual side.

### 3. Impacted d23

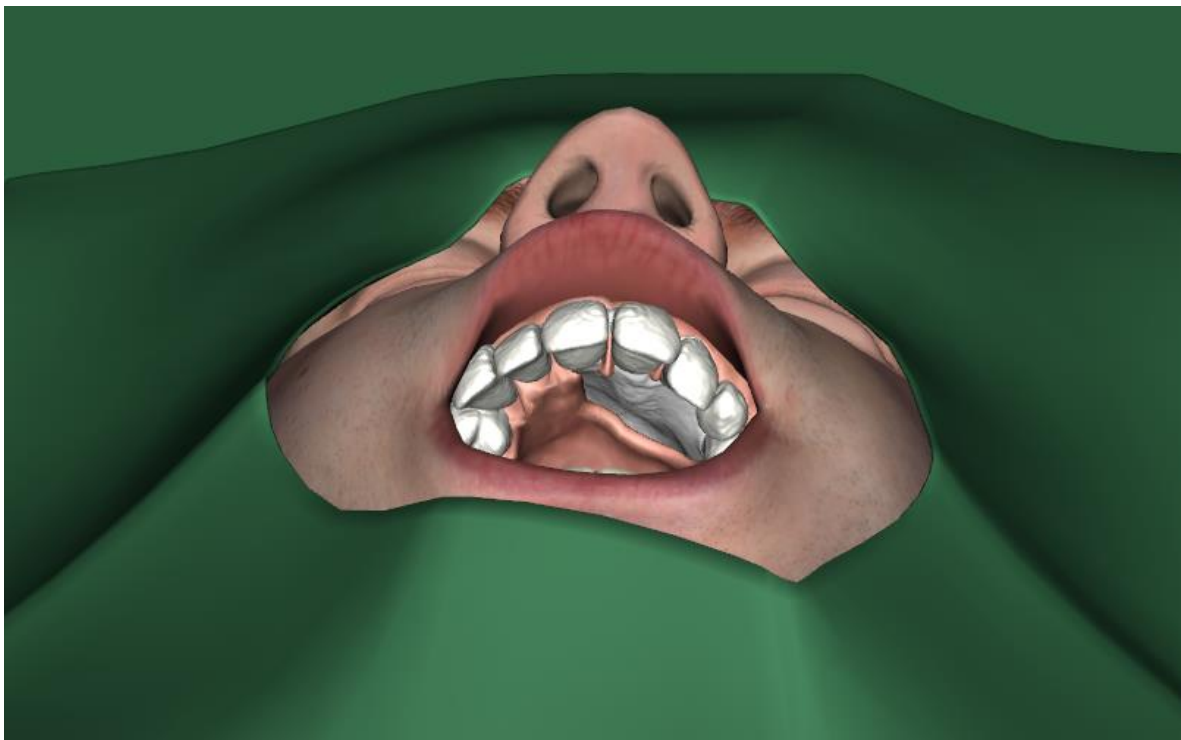


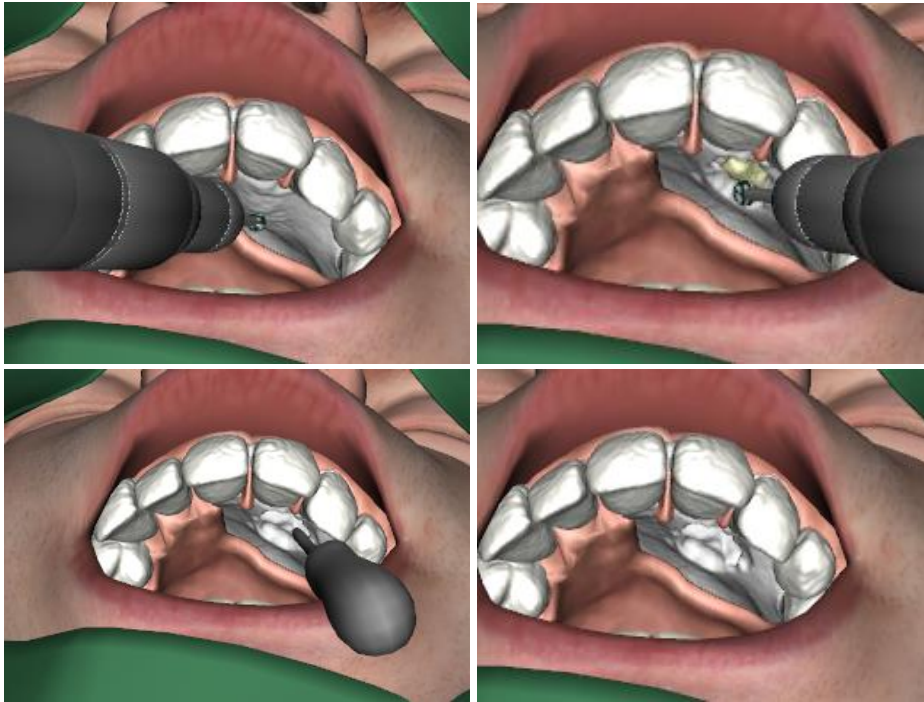
#### Patient

Girl, 15 years old, sought medical assistance due to complains of missing d23 and cross bite in left side. After examination, iCAT was made and diagnosed impacted d23 in horizontal plane on the palatal side and root resorption of d21.

#### Treatment plan

Impacted d23 extraction with osteotomy and tooth sectioning.





### **Suggested Solution**

In this procedure it is important to not harm surrounding teeth. Remove bone by the border of the enamel and dentin of the impacted tooth. Section the tooth at this location. Remove the crown and then the root using the elevator. Feel the remaining hole with the elevator.

## 4. Extraction d36

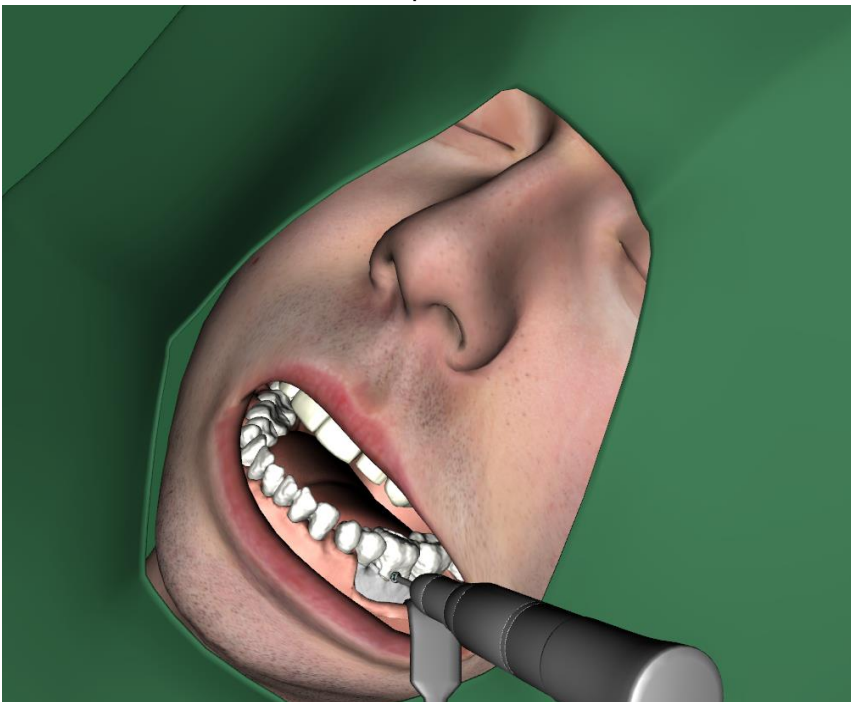


### Patient

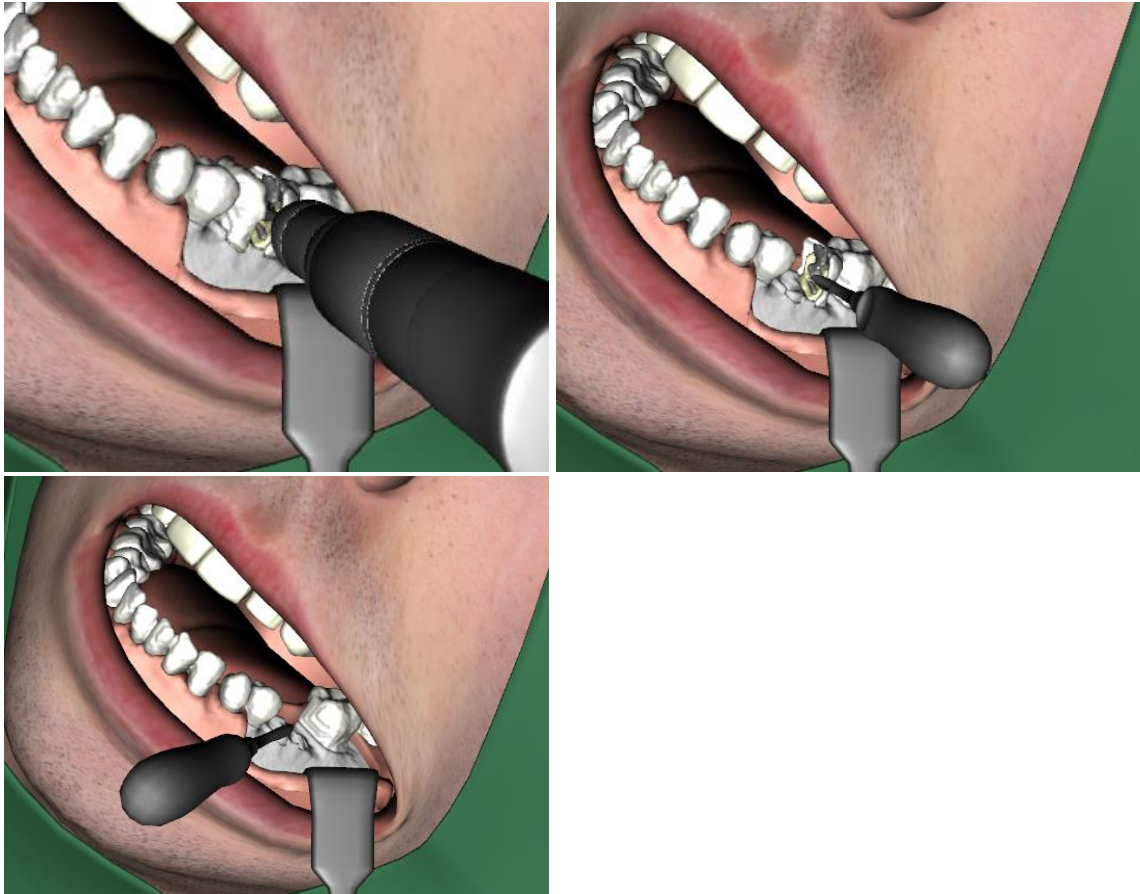
Woman, 25 years old, sought medical assistance due to complains of d36. This tooth bothers patient periodically on the bite. Objectively d36 is stable, probably ankylosed, slightly sensitive to percussion.

### Treatment plan:

Tooth 36 extraction with root separation.



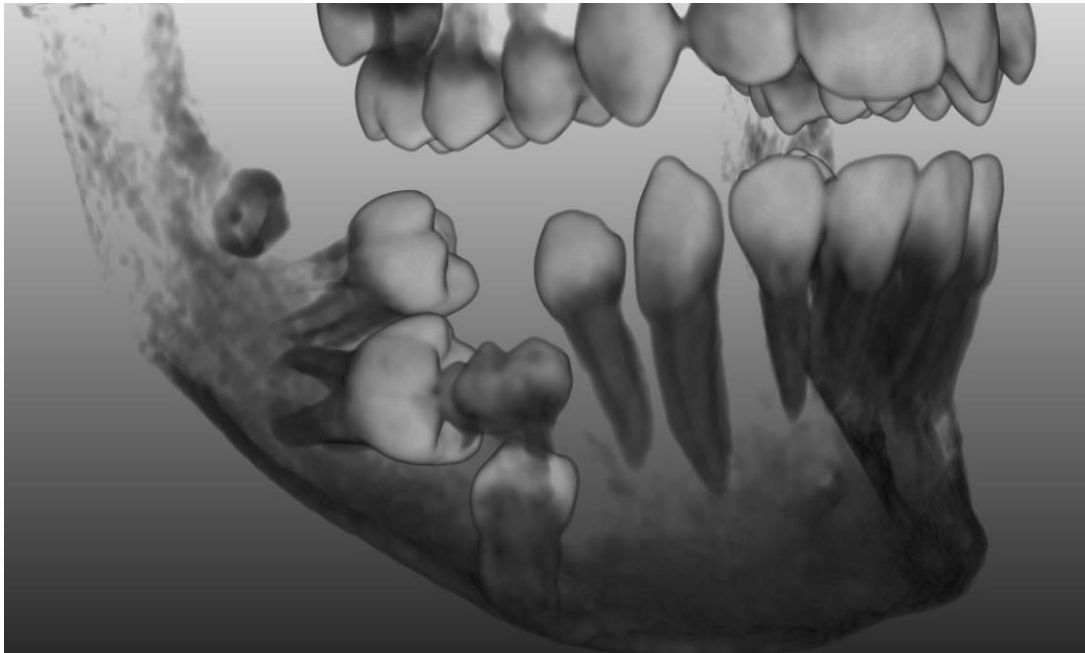




### **Suggested Solution**

Section the crown and down to the root separation. Remove some bone if necessary. Apply the elevator on each tooth half.

## 5. Impacted d85

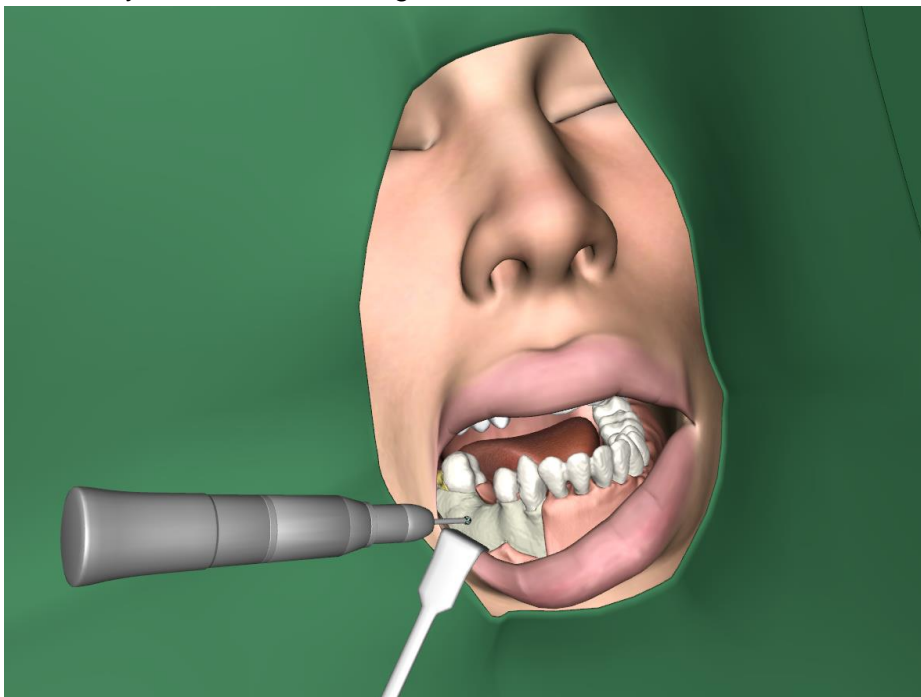


### Patient

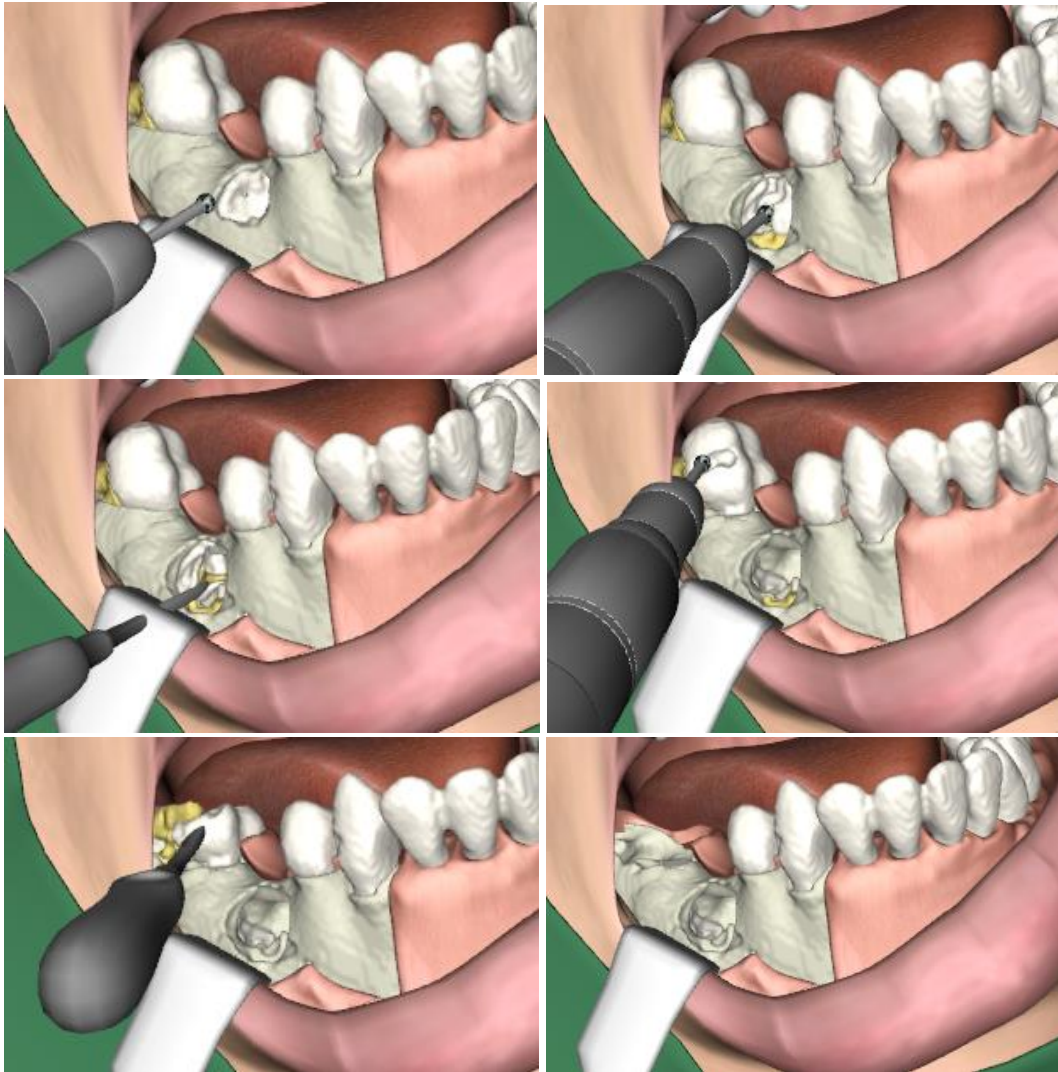
Patient: Girl, 16 years old, sought medical assistance due to complains of missing d45 and d46. After examination, iCAT was made and diagnosed impacted d85 (probably ankylosed) and impacted d45 and d46.

### Treatment plan

1) Impacted d85 extraction with osteotomy and tooth sectioning. 2) D47 extraction with osteotomy and tooth sectioning.







### **Suggested Solution**

Begin by removing bone to access the impacted d85, then section it vertically and, if needed, horizontally. Remove each part of the tooth using the elevator. Section the d47 from the crown and down between the roots. Pry out each part with the elevator.

## 6. Apicoectomy d22

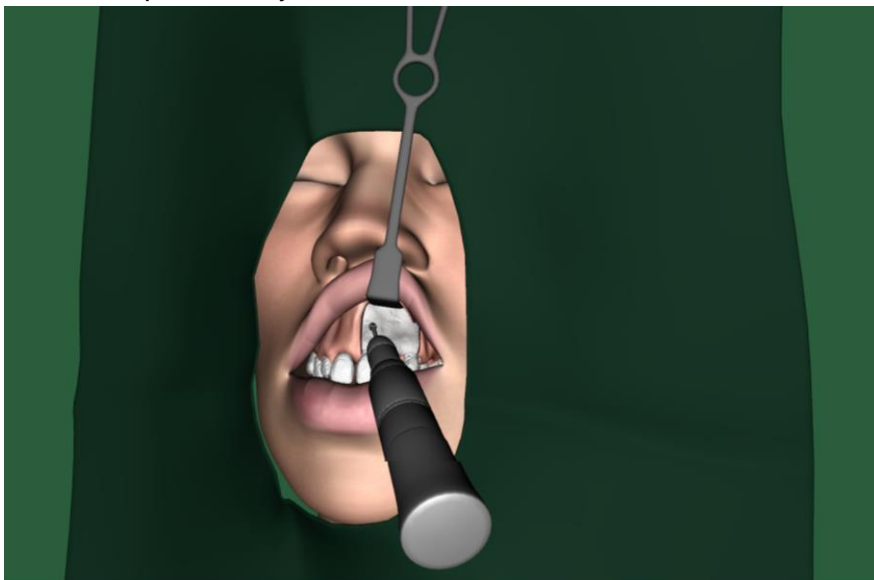


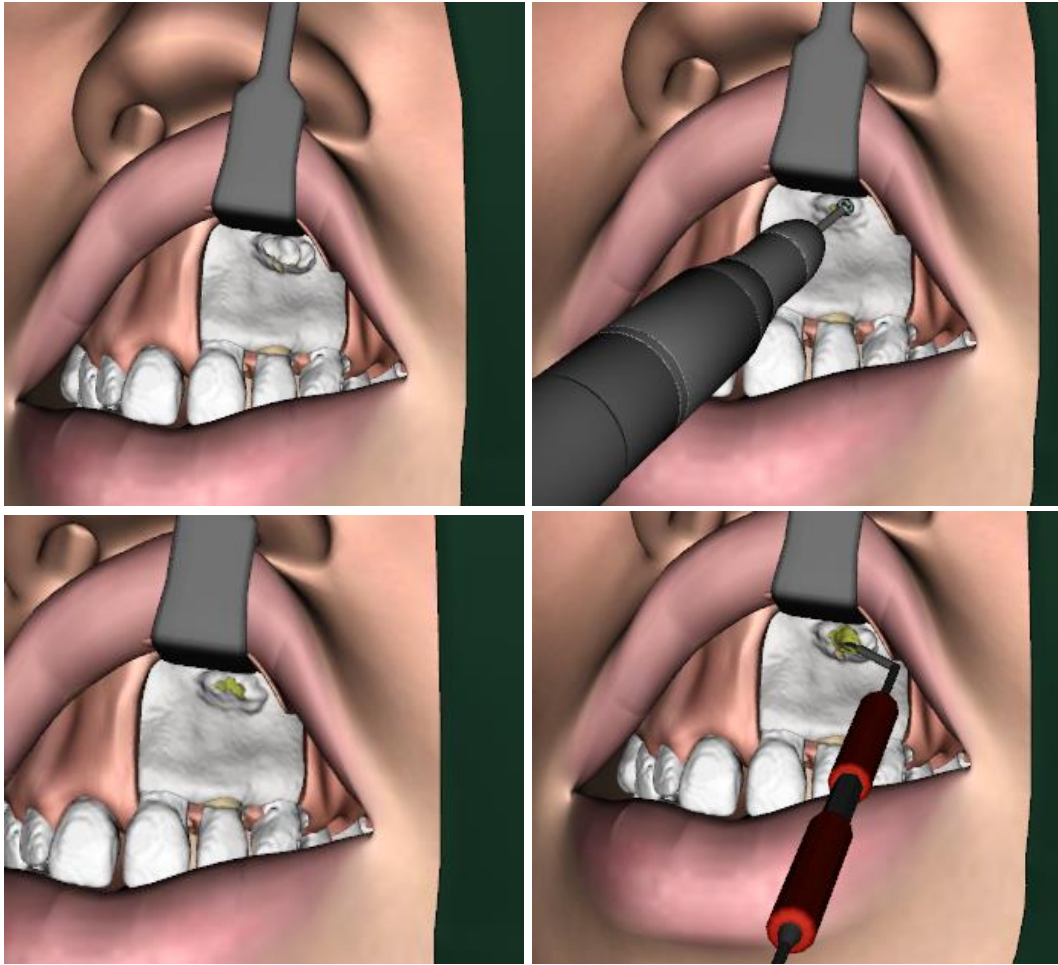
### Patient

Woman, 37 years old, sought medical assistance due to complaints of d22. This tooth bothers patient periodically on the bite. Objectively d22 is stable, slightly sensitive to percussion, with qualitative endodontic treatment.

### Treatment plan:

Tooth 22 apicoectomy





### **Suggested Solution**

Access the apex of the root by removing bone. Use the excavator (right pedal) to remove the infected tissue. Make sure to feel around the cavity to remove it all.