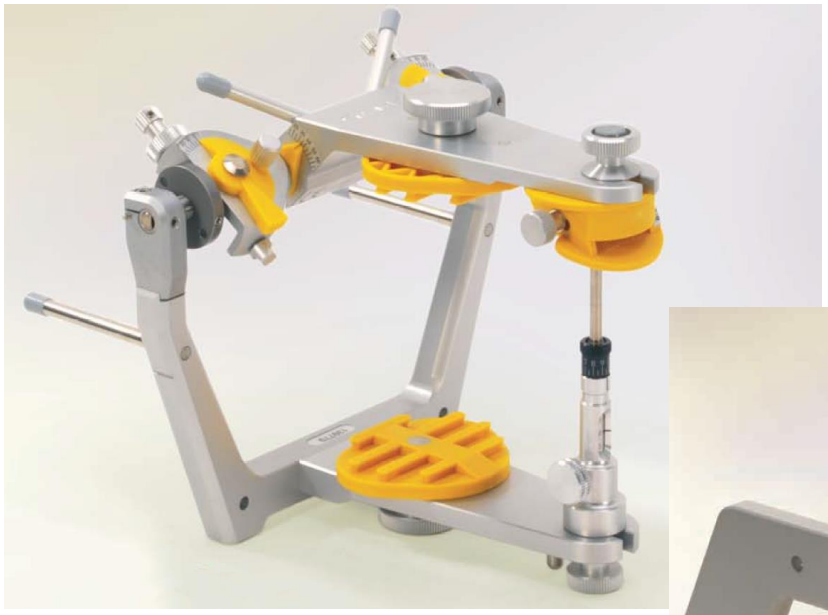
Tiops Cephalometric Analysis:
Protocol for Orthognathic Surgery Planning using



SAM® 3 Articulator

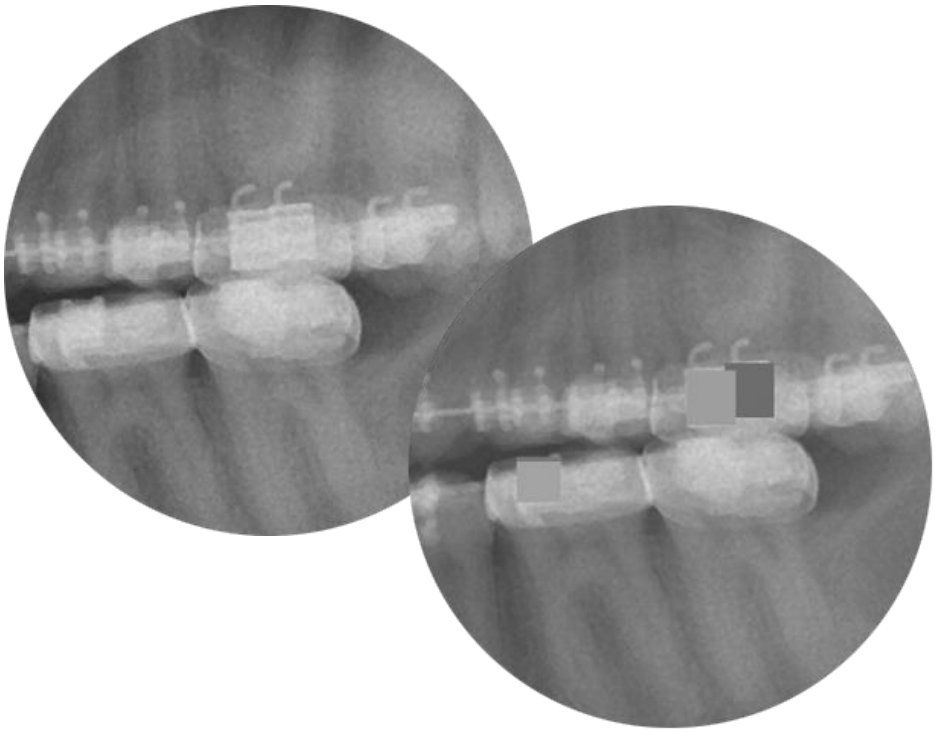
SAM® RMI 500
3D Reference Measure Instrument

Measures x, y, and z coordinates of selected points on articulator mounted casts when placed on the instrument.

http://www.sam-dental.de/pages/engl_catal.html

Surgery planning can be done effectively with the Tiops4 program.....

The Reference Landmarks.....



Procedure

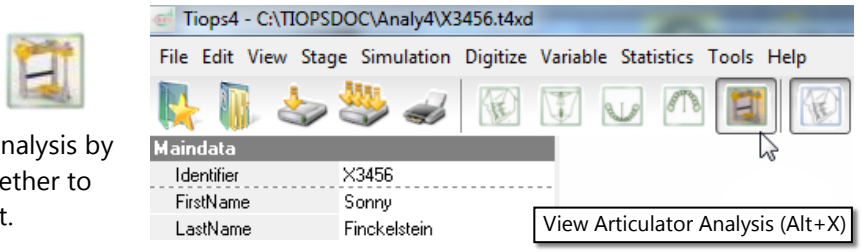
1. Digitize the lateral headfilm and save the file. In order to obtain a valid surgical simulation it is important that certain points are identified correctly. The transfer from the articulator is based on the precise horizontal and vertical location of each of the following landmarks defining the 3D position of the lower and upper dentition:

LowerIncisor		
IncisalInfIncisor	iii	Midpoint of the incisal edge of the most prominent lower incisor on the X-Ray and the dental model
LowerDentitionReferences		
LowerDentitionRefPoint	idr	Point defining the position of the right side dorsal mandibular dentition on the X-Ray and the dental model
LowerDentitionRefPointLeft	idrl	Point defining the position of the left side dorsal mandibular dentition on the X-Ray and the dental model
UpperIncisor		
IncisalSupIncisor	isi	Midpoint of the incisal edge of the most prominent upper incisor on the X-Ray and the dental model
UpperDentitionReferences		
UpperDentitionRefPoint	sdr	Point defining the position of the right side dorsal maxillary dentition on the X-Ray and the dental model
UpperDentitionRefPointLeft	sdrl	Point defining the position of the left side dorsal maxillary dentition on the X-Ray and the dental model

   For landmark definitions see: http://www.tiops.com/downloads/T4Doc/Tiops4Landmarks.pdf

2. Before proceeding with the Articulator analysis check that the headfilm has been correctly digitized and that the landmarks are correctly located. You should also check the x-ray enlargement of the initial headfilm once more to make sure it is correct. If you have entered the image resolution yourself check it as well. These two factors can now be changed without having to redo the analysis.

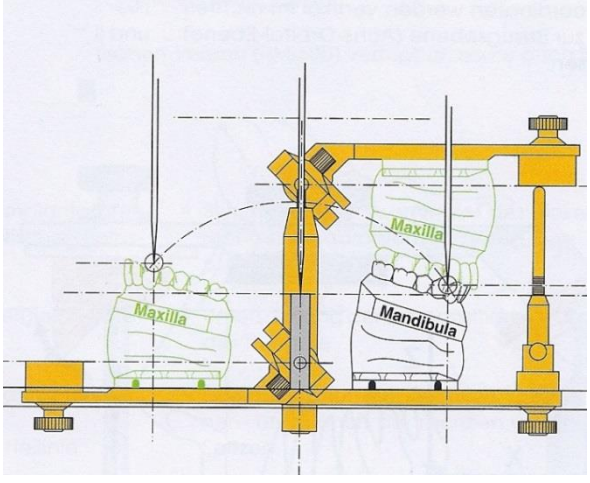
3. Select the View Articulator Analysis icon or click <Alt> and <X> together. Then initiate the articulator analysis by clicking <Ctrl> and <Q> together to open the Articulator segment.



4. Check the Incisor Pin height on the articulator and enter this figure in mm with one decimal under PinHeight. A positive value indicates an opening of the articulator. Remember to select the correct type of SAM articulator under ArticulatorType.

   Note: Do not enter any values in the last six fields at this time.

5. Measure the coordinates of the mounted models in all three planes of space using the SAM Reference Measure Instrument and enter the values in hundreds of a millimeter in the X, Y and Z (left side has neg. values) fields of the LowerMain and UpperMain segments respectively (Open segment to enter values). The mounting plates of the articulator mounted model fits directly onto the pins of the measuring instrument.



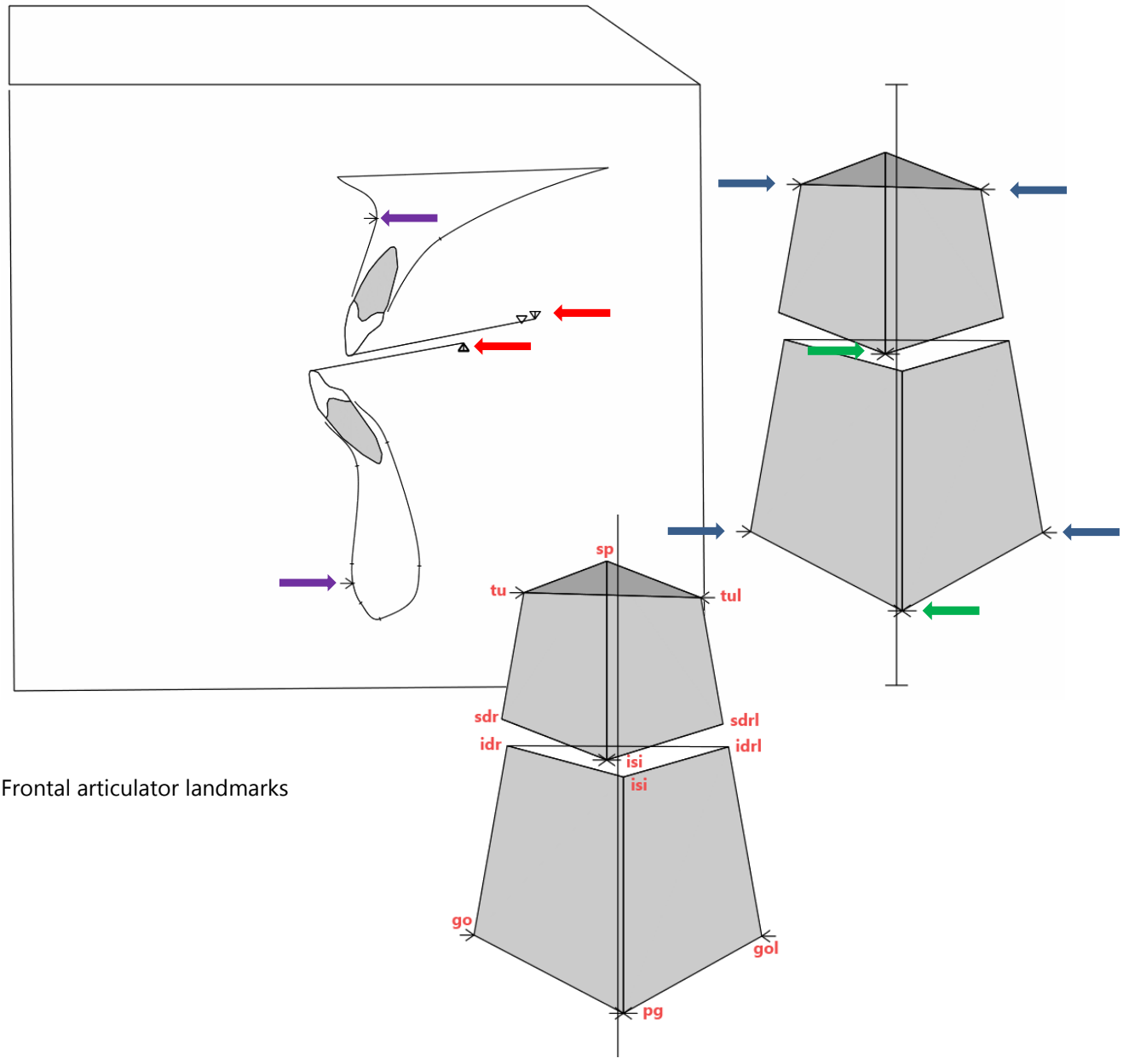
Articulator	
Date	01-01-13
ArticulatorType	SAMIII
PinHeight	1
MidlineShift	0
HorizRotIncCen	0
RightMaxVertAdjust	0
LeftMaxVertAdjust	0
VerticalShift	0
VertRotIncCen	0
Points	
LowerMain	
iii	[7020,5050,-100]
X	7020
Y	5050
Z	-100
idr	[3940,4510,2000]
X	3940
Y	4510
Z	2000
idrl	[3940,4530,-2000]
X	3940
Y	4530
Z	-2000
UpperMain	
isi	[6220,4800,200]
X	6220
Y	4800
Z	200
sdr	[2470,4060,2100]
X	2470
Y	4060
Z	2100
sdrl	[2740,4150,-1900]
X	2740
Y	4150
Z	-1900

6. If an intra-maxillary surgical osteotomy is performed the coordinates of these additional landmarks are to be entered.

UpperCanine		
CuspSupCanine	csc	Cusp tip of the upper canine
CuspSupCanineLeft	cscl	Cusp tip of the upper left canine
UpperBicuspid		
CuspSupBicuspid	csp	Cusp tip of the upper bicuspid
CuspSupBicuspid	cspl	Cusp tip of the upper left bicuspid

UpperSplit	
csc	[4800,4600,1600]
X	4800
Y	4600
Z	1600
csp	[4500,4400,1700]
X	4500
Y	4400
Z	1700
cscl	[5000,4600,-1600]
X	5000
Y	4600
Z	-1600
cspl	[4700,4400,-1700]
X	4700
Y	4400
Z	-1700

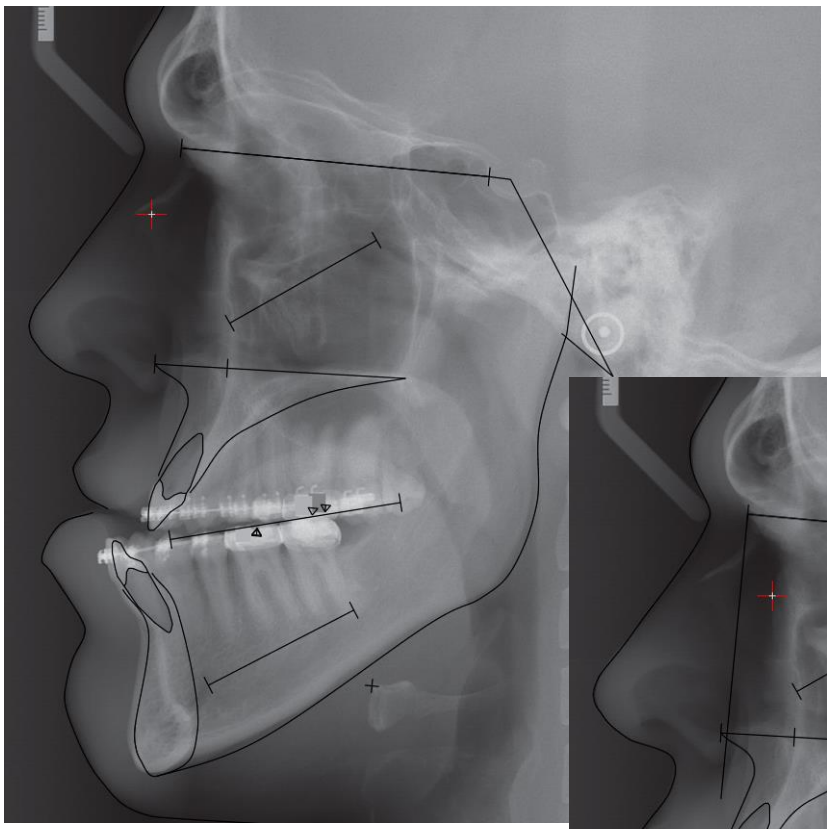
This procedure locates the models in the articulator in the Lateral as well as the Frontal view.
The small triangles seen on the Lateral view below represents the Dentition Reference Landmarks.
The right triangle contains a vertical line.
The arrows seen on the Lateral view mark the original position of the bony landmarks ss and pg.
The arrows seen on the Frontal view mark the original position of the bony landmarks shown.
The double arrows mark the original position of the upper midline represented by the articulator landmark isi and the position of the landmark pg respectively.
Note the discrepancies of the jaw midlines in relation to the median plane of the articulator, which may or may not correspond to the clinical observed midline of the face.

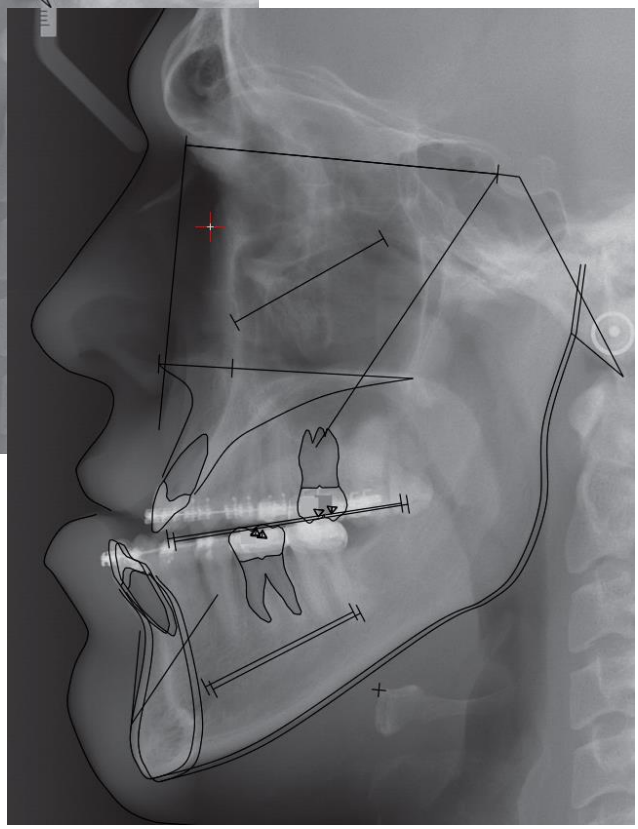


Frontal articulator landmarks

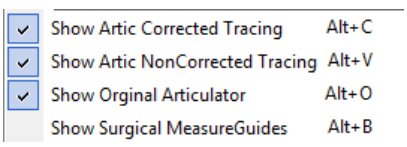
7. Now check the LateralView by selecting the corresponding icon  or click <Alt> and <Z> together.
   The position of the tracing is guided by the upper incisor. The position of the lower jaw tracing in relation to the X-ray is repositioned using position of the upper and lower dentition landmarks recorded in the articulator.
   Any difference is compensated for by the program when performing the simulation, when this difference is due to a discrepancy between the condylar position on the Mounted Models and the position of the condyles on the Lateral Headfilm. This difference is observed in most cases, but will as mentioned not impair the simulation.

   Note: When the difference between the two tracings is due to a true difference in recognition and consequently the registration of the teeth on the models and the headfilm, the system will not be able to perform the calculations of the lateral cephalometric changes correctly. However, the calculated changes in the articulator remain true.





The original (non-corrected) tracing including the molars can also be visualized or removed selecting the appropriate entrance in the View Menu or by clicking <Alt> and <V>

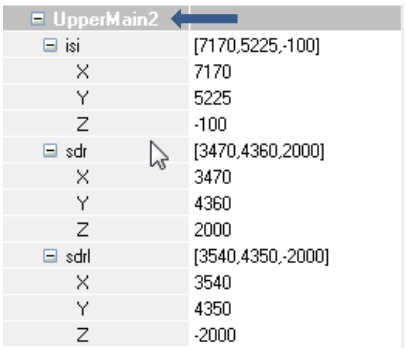


8. The next step is to separate, by cutting the plaster base of either the upper or the lower mounted model from its articulator mounting plate, which ever makes the most sense for the future surgical plan. In case of bi-maxillary surgery it is most practical to cut the most asymmetrical jaw first.

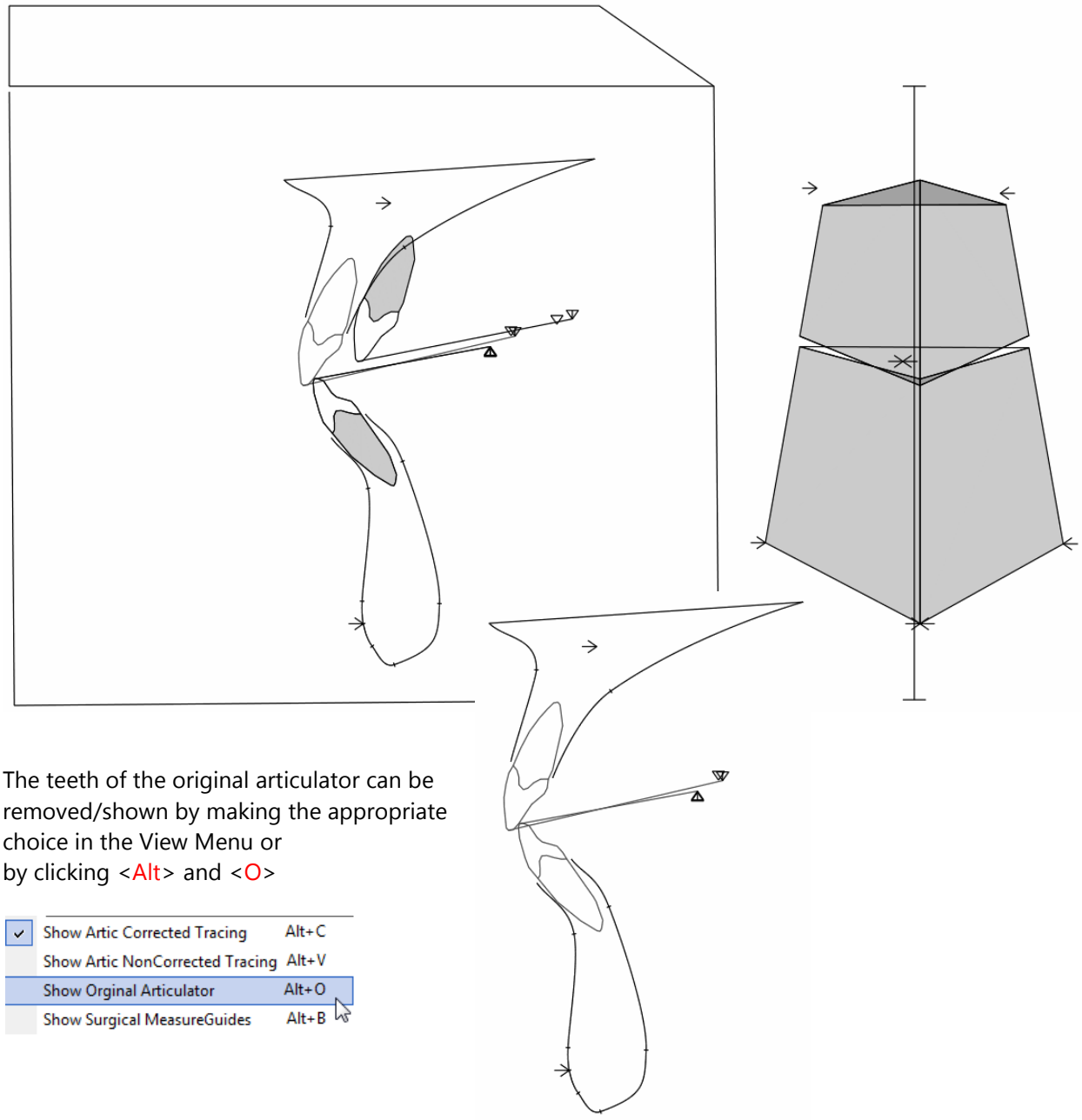
   Now the separated model is placed in the desired Occlusion with any pre planned transverse/sagittal sectioning of the upper jaw already performed. (See 6.)

   While maintaining the upper and lower models in occlusion, the previously released jaw/cast is then remounted to the base plate in the articulator while maintaining the same incisal pin height.

   Now the remounted jaw model is measured by means of the 3D Reference Measure Instrument once again and the coordinates entered into the respective cells in the listing under the corresponding Main2 Frame.



9. The teeth can now be seen in the newly planned occlusion, as illustrated below (white teeth) as well in their initial position (the teeth with the root fill). In this case the Upper Jaw was chosen to be repositioned in the desired Occlusion.



   The teeth of the original articulator can be removed/shown by making the appropriate choice in the View Menu or by clicking <Alt> and <O>

Now the necessary correction of asymmetries can be performed by virtually moving the interlocked Upper and Lower dentition carrying jaw segments using these parameters:

- MidlineShift
  Horizontal change in the horizontal plane of the articulator (mm, negative value for left)

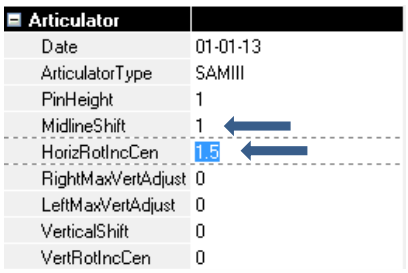
- HorizRotIncCenter
  Horizontal rotation in the horizontal plane of the articulator with a center of rotation at the landmark isi (deg, negative value for counterclockwise/left)

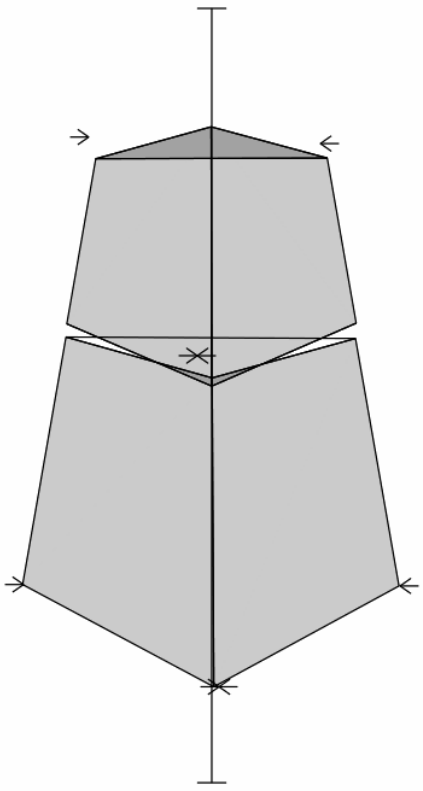
- RightMaxVertAdjust
  Vertical rotation/Change of the landmark sdr with a rotation axis defined by the landmarks isi and sdrl (deg, negative value cranial direction)

- LeftMaxVertAdjust
  Vertical rotation/Change of the landmark sdrl with a rotation axis defined by the landmarks isi and sdr.

- VerticalShift
  Vertical change in the vertical plane of the articulator (mm, negative value for up)

- VertRotIncCenter
  Vertical rotation in the vertical plane of the articulator with a center of rotation at the landmark isi (deg, negative value for counterclockwiset)





Note: The position of the jaw midlines in relation to median plane of the articulator may or may not correspond to the clinical observed midline of the face.
To obtain the desired position the dental midline it should eventually be moved away from the articulator midline.

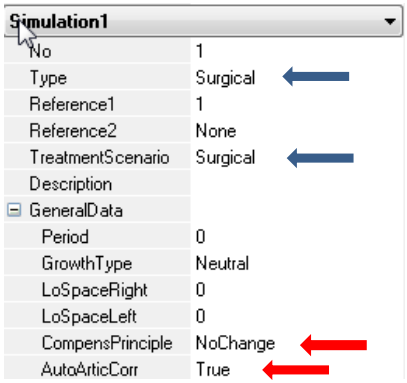
Note: Using the variables RightMaxVertAdjust and LeftMaxVertAdjust will consequently move the interlocked Upper and Lower dentition in a direction not corresponding to the midline plane. Nevertheless the program calculates the resulting movements correctly in both the lateral articulator and the lateral cephalometric tracing.
When the lateral analysis landmarks in both sides are registered the right and left sides are shown accordingly.
If only the right side lateral analysis landmarks are registered the tracing represents the corresponding right side changes.

10. At this point and not before the actual surgical simulation procedure can be started by pressing the icon 

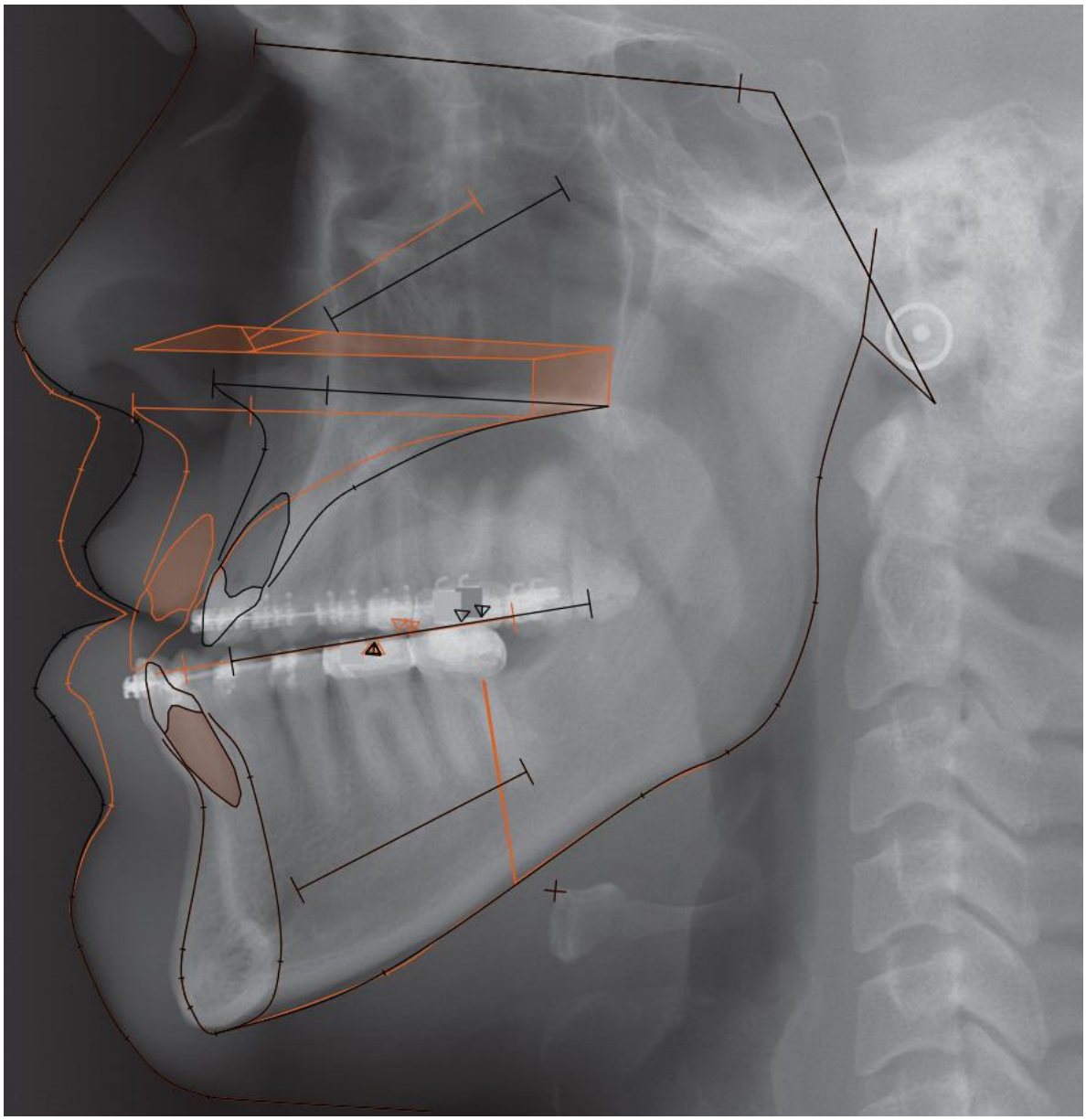
Then choose Surgical as the Type and Surgical as the TreatmentScenario.

This choice will set the CompensPrinciple to NoChange and the simulation variable AutoArticCorr will be set to True.

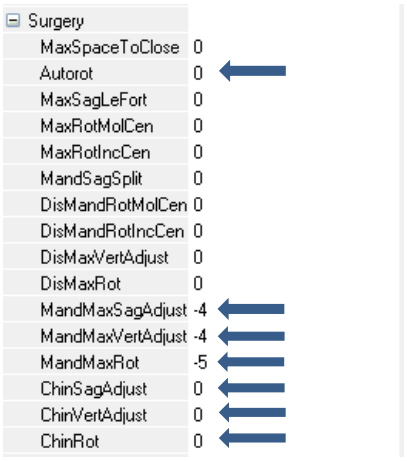
If the latter is set to False then the condyles in the Simulation will be shown in their initial position corresponding to the position on the non-corrected lateral headfilm (see next page).

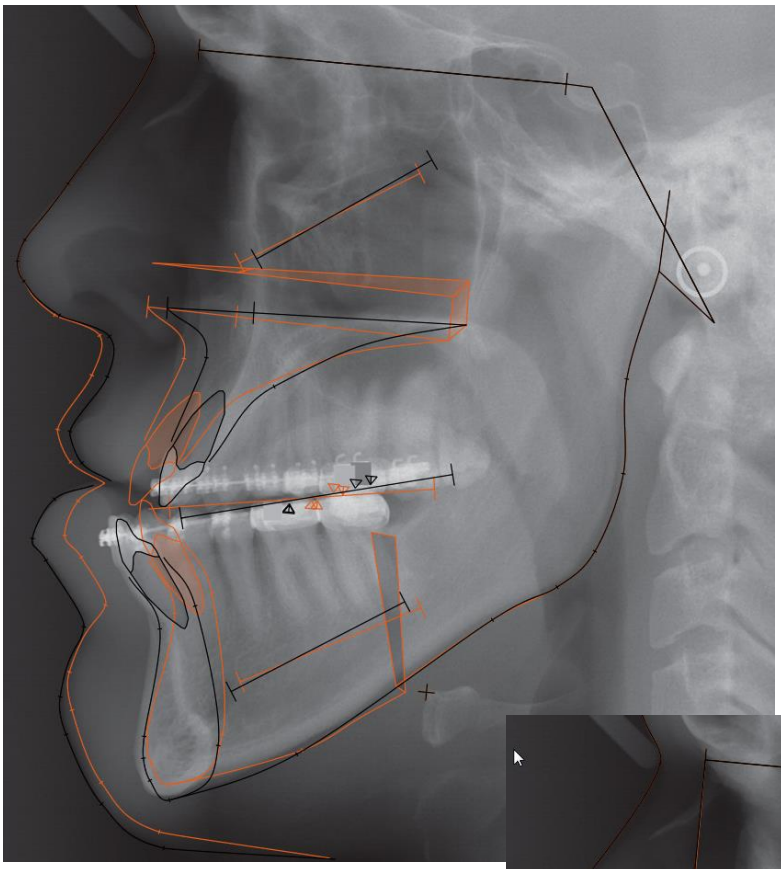


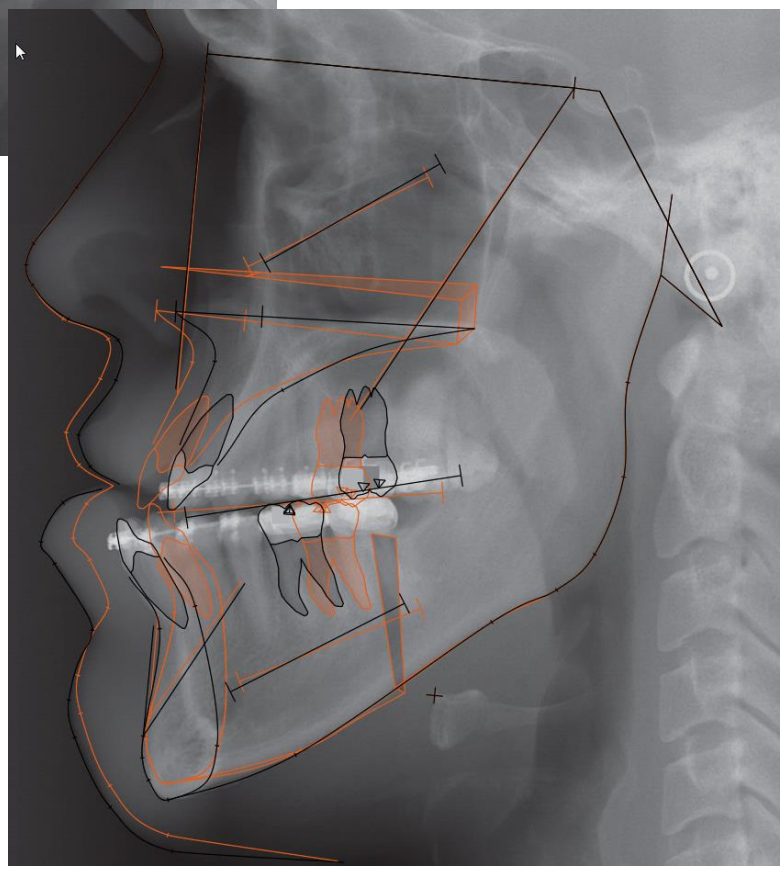
11. Using the above explained procedure a cephalometric simulation has been created where the upper and the lower dental arches have been placed in the exact same relationship as in the articulator.



12. In order to proceed the planning only the variables indicated may be used. Below you see the completed simulation procedure.
IMPORTANT! If any variable, other than the ones indicated, is used there will be no response from the Simulation Procedure. The unmarked variables are only active in the Ortho+Surgical TreatmentScenario







By choosing the View feature

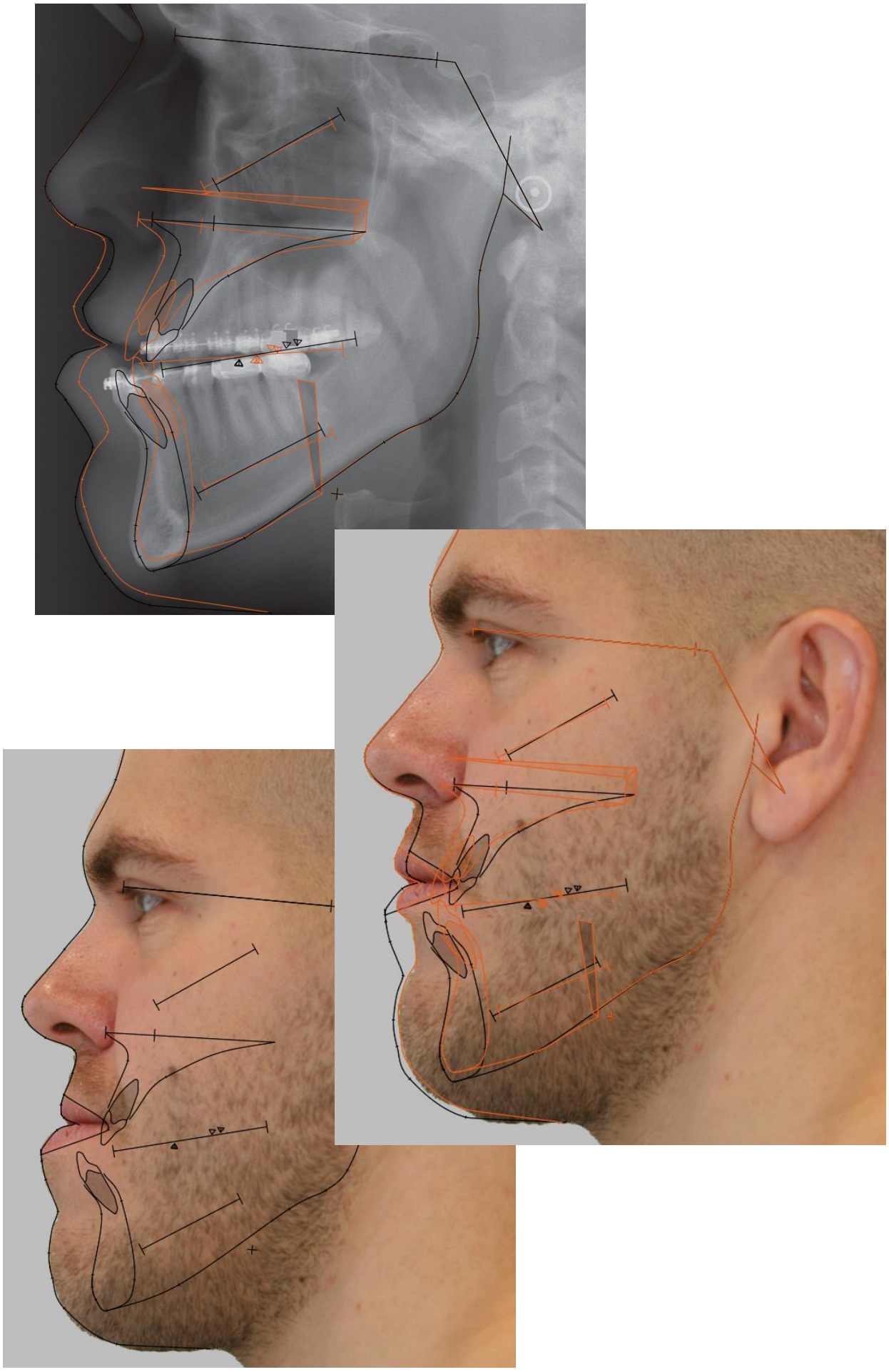
Show Artic NonCorrected Tracing for the Stage

together with the Simulation variables

AutoArticCorr = False
for the Simulation

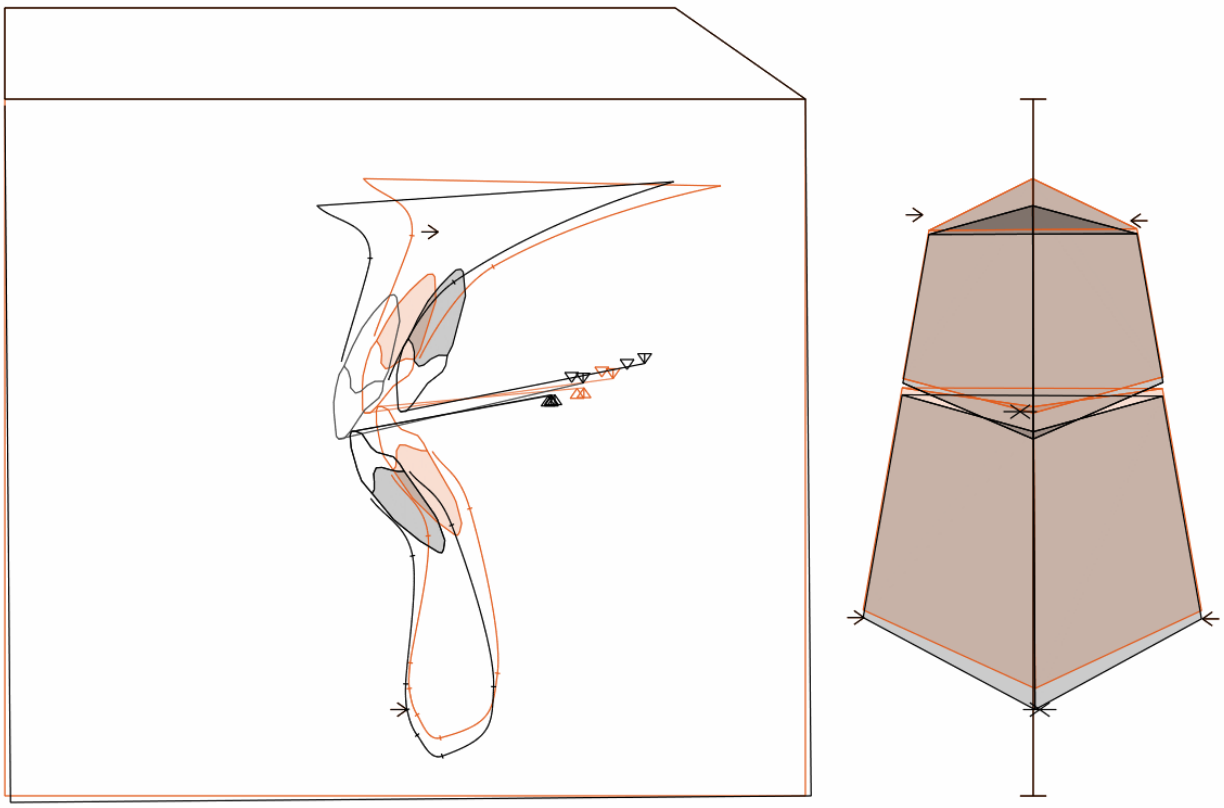
the original cephalometric tracings are displayed.

13. If a Photo is included in the Stage, it will automatically be incorporated in the Simulation.



14. By selecting ArticulatorView and printing out the tracing you will also get the new (Simulation) coordinates for placing the upper jaw in the articulator in the correctly simulated Position. ⟵

    This is done by using the 3D Reference Measure Instrument again using the marked values.



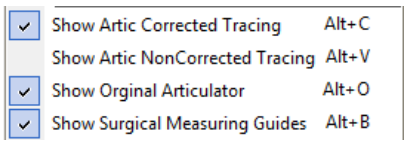
	Stage1					
LowerMain.iii	70.2	50.5	-1.0			
LowerMain.idr	39.4	45.1	20.0			
LowerMain.idrl	39.4	45.3	-20.0			
UpperMain.isi	62.2	48.0	2.0			
UpperMain.sdr	24.7	40.6	21.0			
UpperMain.sdrl	27.4	41.5	-19.0			
				Simulation1		
LowerMain2.iii	70.2	50.5	-1.0	65.7	47.2	-0.1
LowerMain2.idr	39.4	45.1	20.0	34.0	44.3	20.1
LowerMain2.idrl	39.4	45.3	-20.0	35.1	44.5	-19.8
UpperMain2.isi	71.7	52.2	-1.0	67.7	48.2	0.0 ⟵
UpperMain2.sdr	34.7	43.6	20.0	29.6	42.9	20.0 ⟵
UpperMain2.sdrl	35.4	43.5	-20.0	31.3	42.7	-19.9 ⟵

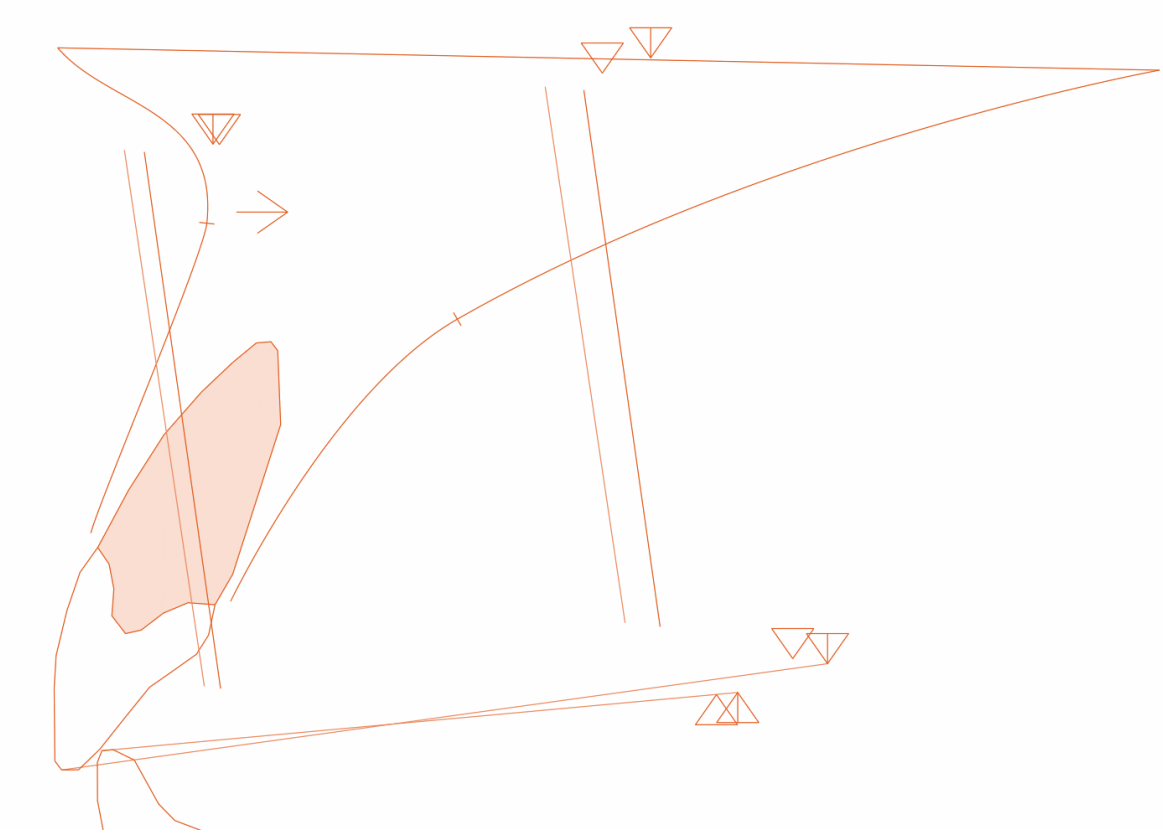
15. After the upper jaw has been placed and secured in the planned Position, the lower jaw is loosened and consequently positioned in the planned Occlusion (see 6) and remounted on the base plate in the articulator.
    The Simulation values for the LowerMain2 equals a setting of the incisal pin height to zero.

16. This will place the lower jaw in the simulated Position.

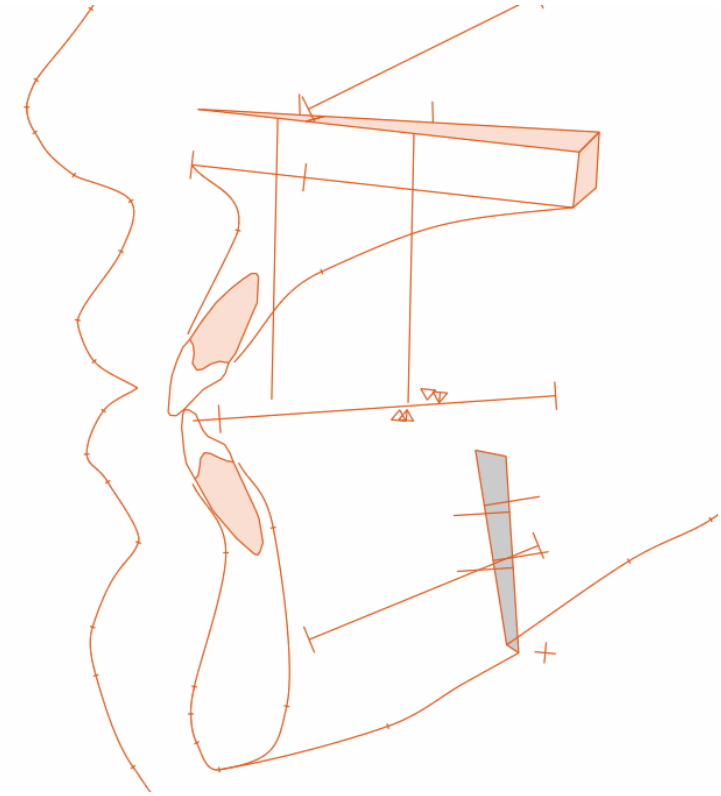
17. Now the stents for the surgery can be made.

18. Selecting View/Show Surgical Measuring Guides will display 3D simulated right and left upper jaw Measurung Guides to monitor the changes in the Articulator View (pretreatment position marked with triangles, left guides are shown in a paler color)





19. The same selection displays 2D simulated upper and lower jaw Measuring Guides in the Lateral View.



20. The repositioning of the upper jaw can eventually be performed using the Modell-Repositionierungs-Instrument nach Prof. Dr. Rainer Schwestka-Polly