

Supplemental

Use Case Tutorial

Spatial Deviations of Mandibular Reconstruction

Input patient basic information in *sheet* "(1)Basic Information".

Basic Information and Demographics of Patient			
Patient ID	QM44	Grouping	
Age (years)	51		
Sex	Male		
Disease	SCC	TNM	T2N0M0
		Staging	2
Brown's classification of mandibular defect	I	Defect side	Left
Donor bone graft	Fibula		
No. of bone graft segments	1		

Notes:

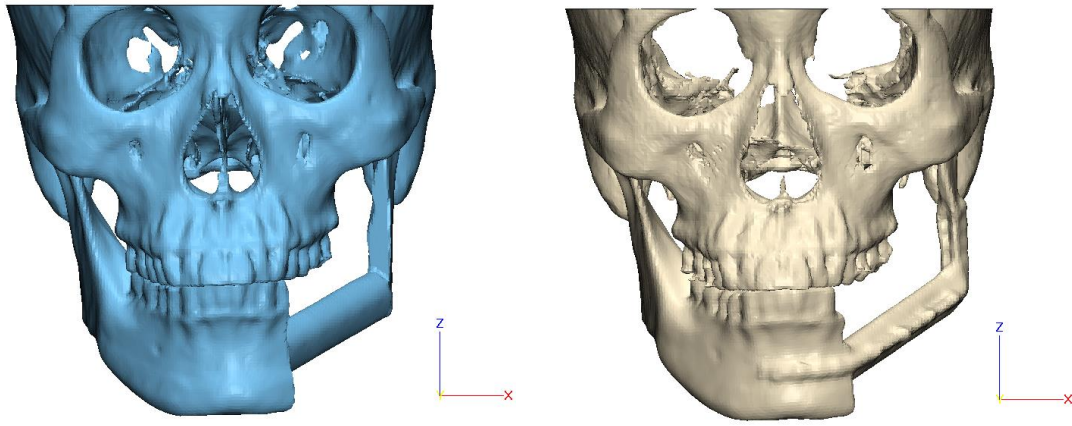
1. Each patient should have a separate *Excel* file of "**CAS Mandible Measurements**";
2. Copy *sheet* "(4)Copy Data" to a new *Excel* file named "**All Patient Data**";
3. Input in *sheet* "(1)Basic Information";
4. Input in *sheet* "(2)Input Points";
5. View results in *sheet* "(3)Output Data";
6. Copy text from *sheet* "(3)Output Data" to *sheet* "(4)Copy Data" in *Excel* "**All Patient Data**".

(1)Basic Information |
 (2)Input Points |
 (3)Output Data |
 (4)Copy Data |
 (+)

Model preparation

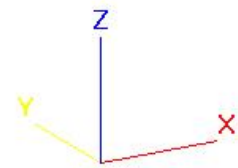
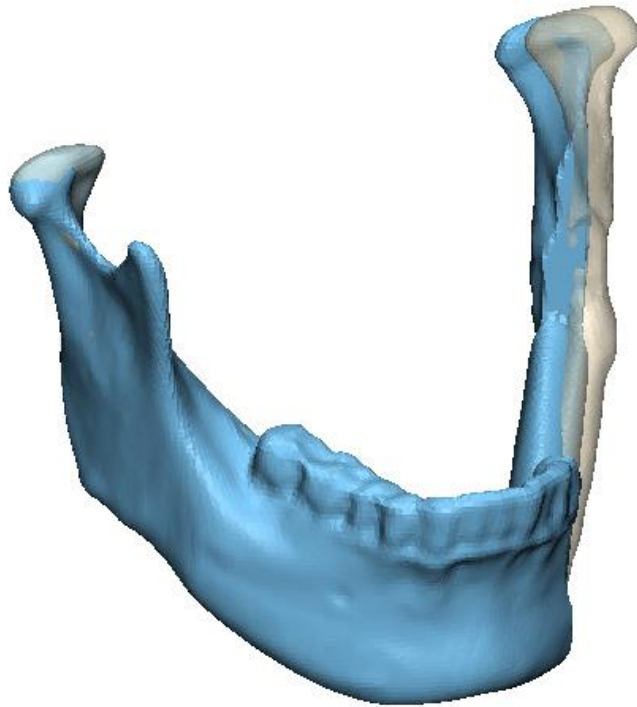
Correct head posture and establish coordinate system.

Left: preoperative skull (blue); right: postoperative skull (yellow).



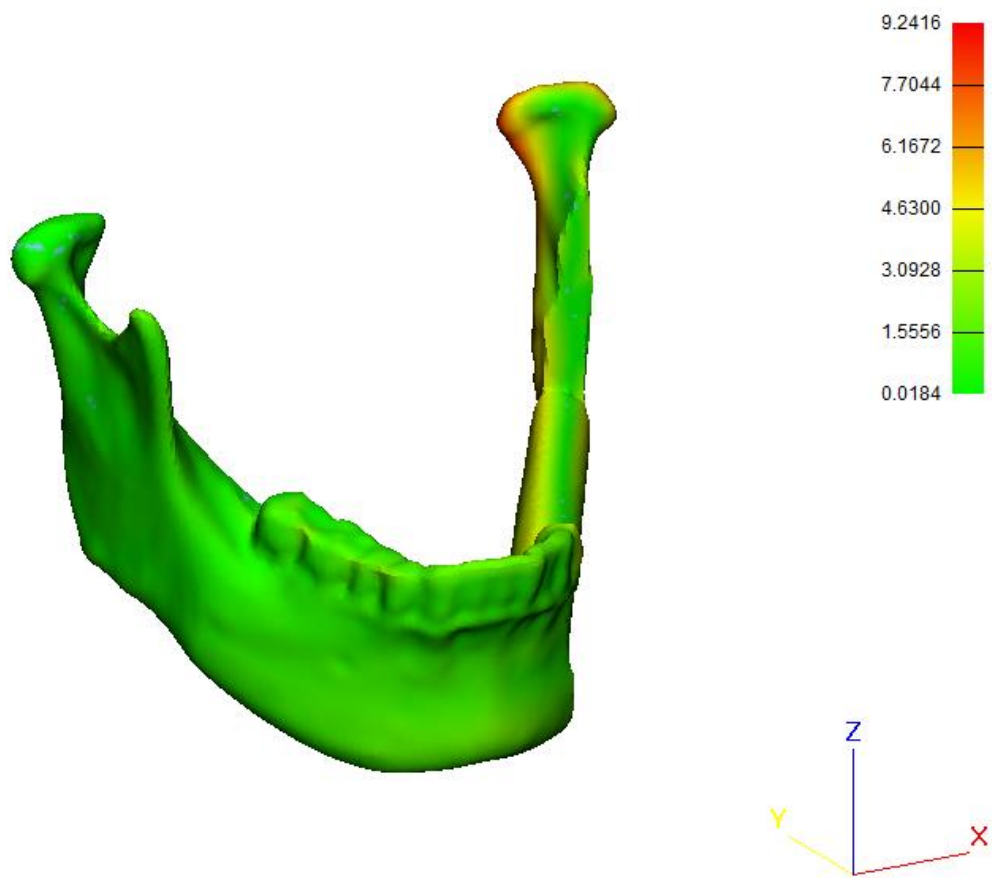
Superimposition based on non-operated side of mandible.

When measuring spatial deviations of reconstruction, mandibles are superimposed based on the non-operated side, and therefore spatial deviations in the operated side can be visualized and analyzed.



Category: overall deviations.

Absolute deviation of neomandible



Output Data:

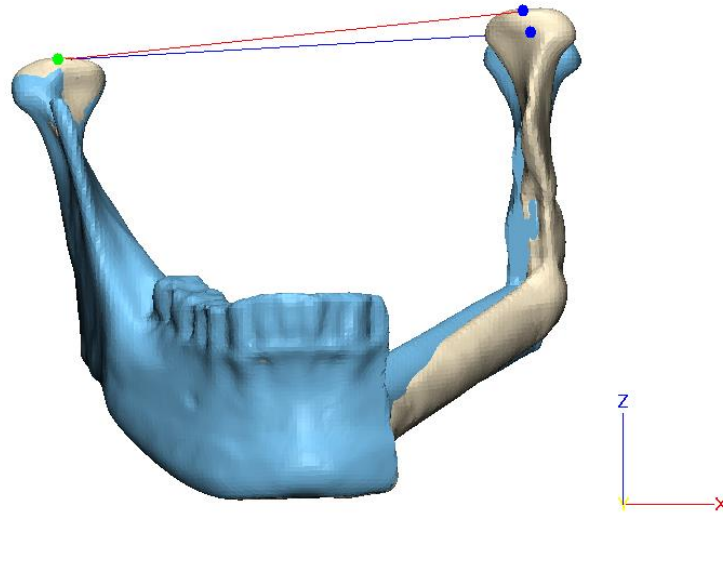
Absolute Deviation of Neomandible (mm)		
Mean	SD	RMS
1.3846	1.776	2.2519

Category: condylar deviations.

Spatial shifts of condylion

Distance deviation of intercondylar width

Angular deviation of intercondylar line



Input Points:

Preoperative virtually-planned mandible				Postoperative reconstructed mandible			
Operated Side				Operated Side			
	x	y	z		x	y	z
Condylion (Co)	162.9709	98.0955	130.5582	Condylion (Co)	161.2554	87.0235	135.4238
Lateral pole of condyle (C/p)				Lateral pole of condyle (C/p)			
Medial pole of condyle (C/mp)				Medial pole of condyle (C/mp)			
Gonion (Go)				Gonion (Go)			
Inferior point of mental tubercle (Mt)				Inferior point of mental tubercle (Mt)			
Non-operated Side				Non-operated Side			
	x	y	z		x	y	z
Condylion (Co)	56.071	97.0031	124.4461	Condylion (Co)	56.071	97.0031	124.4461
Lateral pole of condyle (C/p)				Lateral pole of condyle (C/p)			
Medial pole of condyle (C/mp)				Medial pole of condyle (C/mp)			
Gonion (Go)				Gonion (Go)			
Inferior point of mental tubercle (Mt)				Inferior point of mental tubercle (Mt)			

Output Data:

Spatial Shifts of Condylion (mm)							
Operated Side				Non-operated Side			
3D	A-P	S-I	M-L	3D	A-P	S-I	M-L
12.214919	11.072	4.8654	1.7155	0	0	0	0

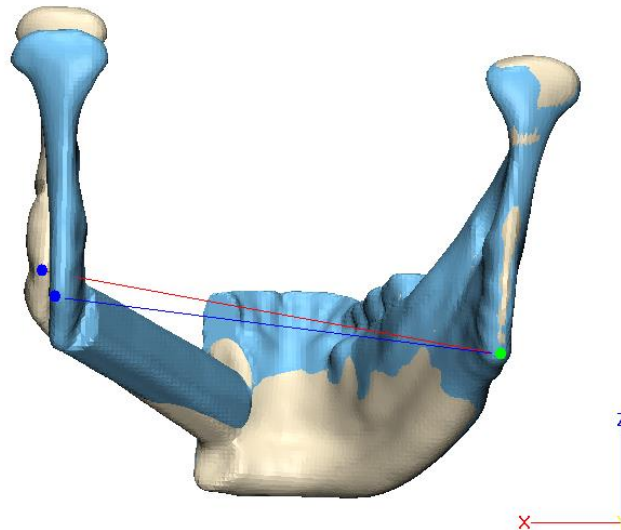
Intercondylar Head Deviations			
Pre-	Post-	Distance Deviation (mm)	Angular Deviation (°)
107.08006	106.2255	0.8545666	6.549612

Category: gonial deviations.

Spatial shifts of gonion

Distance deviation of intergonial width

Angular deviation of intergonial line



Input Points:

Preoperative virtually-planned mandible				Postoperative reconstructed mandible			
Operated Side				Operated Side			
	x	y	z		x	y	z
Condylion (Co)	162.9709	98.0955	130.5582	Condylion (Co)	161.2554	87.0235	135.4238
Lateral pole of condyle (C/p)				Lateral pole of condyle (C/p)			
Medial pole of condyle (Cmp)				Medial pole of condyle (Cmp)			
Gonion (Go)	163.9985	105.566	70.438	Gonion (Go)	166.8945	102.5967	76.348
Inferior point of mental tubercle (Mt)				Inferior point of mental tubercle (Mt)			
Non-operated Side				Non-operated Side			
	x	y	z		x	y	z
Condylion (Co)	56.071	97.0031	124.4461	Condylion (Co)	56.071	97.0031	124.4461
Lateral pole of condyle (C/p)				Lateral pole of condyle (C/p)			
Medial pole of condyle (Cmp)				Medial pole of condyle (Cmp)			
Gonion (Go)	63.2603	103.2299	57.4665	Gonion (Go)	63.2603	103.2299	57.4665
Inferior point of mental tubercle (Mt)				Inferior point of mental tubercle (Mt)			

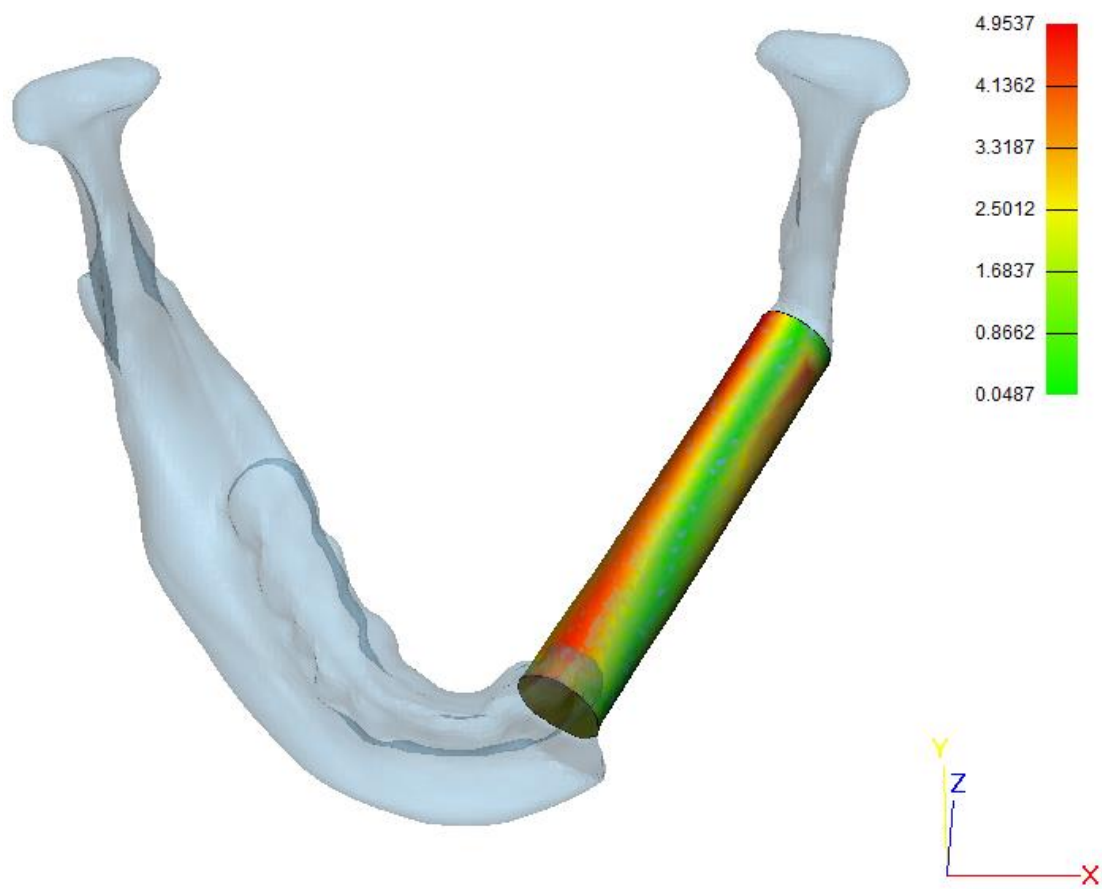
Output Data:

Spatial Shifts of Gonion (mm)							
Operated Side				Non-operated Side			
3D	A-P	S-I	M-L	3D	A-P	S-I	M-L
7.2202257	2.9693	5.91	2.896	0	0	0	0

Intergonial Deviations			
Pre-	Post-	Distance Deviation (mm)	Angular Deviation (°)
101.59676	105.34211	3.7453441	3.419257

Category: bone graft deviations

Absolute deviation of bone graft



Output Data:

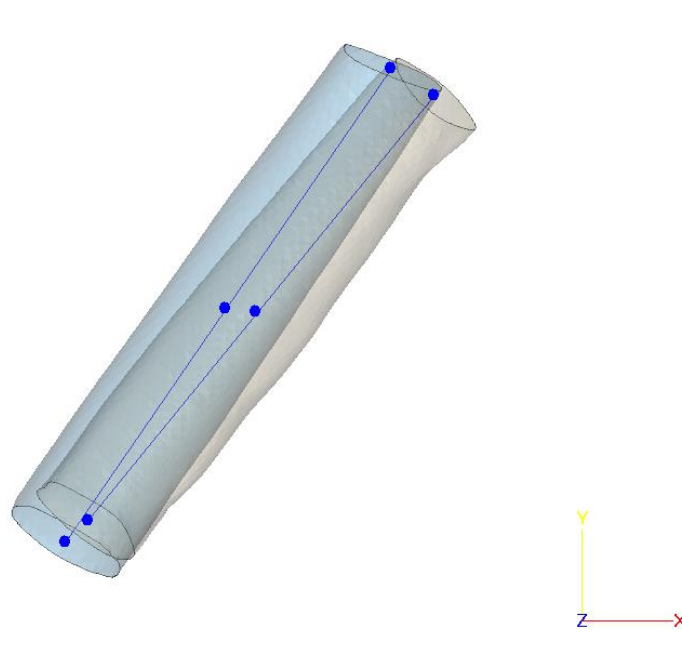
Absolute Deviation of Bone Graft (mm)		
Mean	SD	RMS
2.3639	1.3393	2.7169

Category: bone graft deviations.

Distance deviation of bone graft

Angular deviation of bone graft

Length deviation of bone graft



Input Points:

Preoperative virtually-planned mandible				Postoperative reconstructed mandible			
Bone graft_s1				Bone graft_s1			
	x	y	z		x	y	z
Center point of bone graft_s1 (CG_s1)	142.237	69.0544	55.6737	Center point of bone graft_s1 (CG_s1)	145.437	68.7218	55.5787
Long axis of bone graft_s1 (LAX_s1)				Long axis of bone graft_s1 (LAX_s1)			
From point A	159.6806	94.3235	65.5174	From point A	164.1814	91.4285	68.6202
To point B	125.3894	44.4708	46.6058	To point B	127.7551	46.7702	43.8504

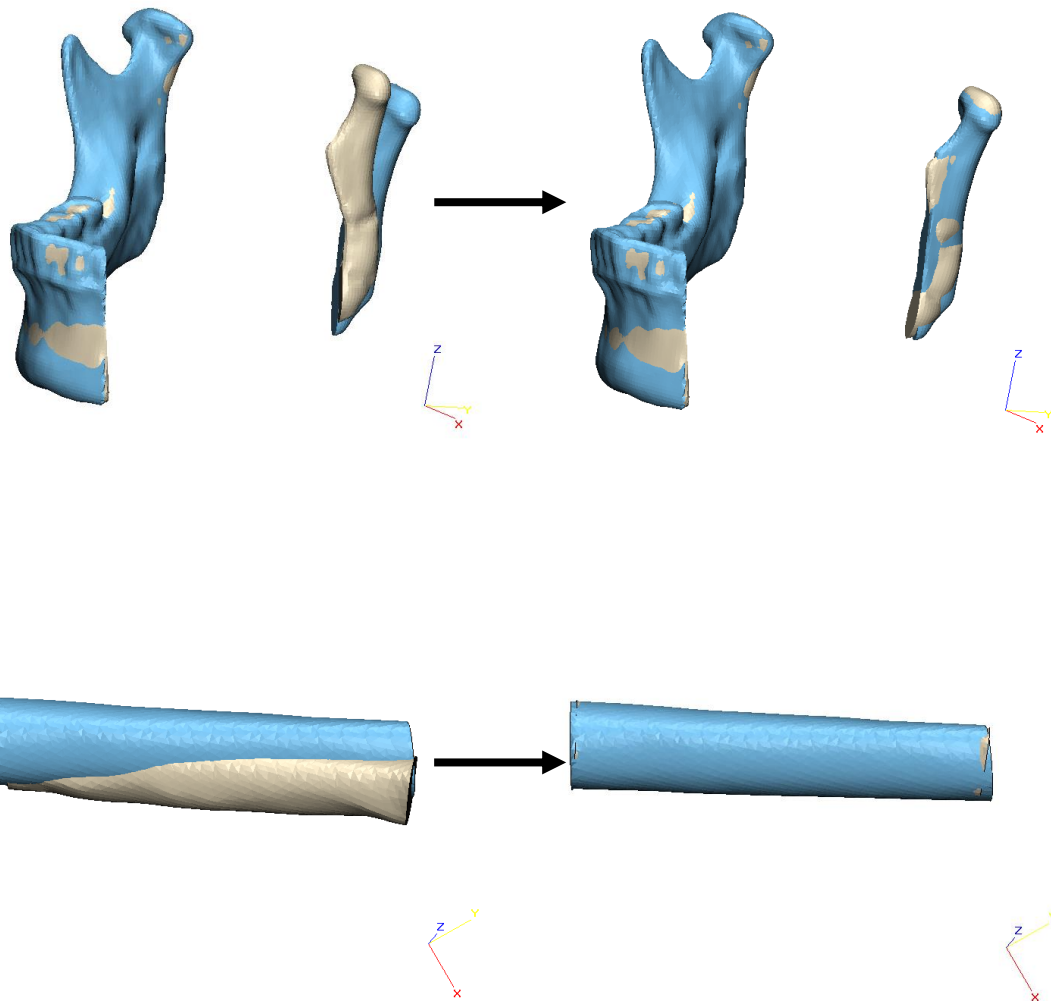
Output Data:

Distance and Angular Deviations of Bone Grafts							
Bone Graft_s1		Bone Graft_s2		Bone Graft_s3		Bone Graft_s4	
Distance Deviation (mm)	Angular Deviation (°)	Distance Deviation (mm)	Angular Deviation (°)	Distance Deviation (mm)	Angular Deviation (°)	Distance Deviation (mm)	Angular Deviation (°)
3.2186407	7.3536692	0	#DIV/0!	0	#DIV/0!	0	#DIV/0!

Length Deviations of Bone Grafts											
Bone Graft_s1			Bone Graft_s2			Bone Graft_s3			Bone Graft_s4		
Pre-	Post-	Length Deviation (mm)	Pre-	Post-	Length Deviation (mm)	Pre-	Post-	Length Deviation (mm)	Pre-	Post-	Length Deviation (mm)
63.394217	62.727841	0.6663753	0	0	0	0	0	0	0	0	0

Superimposition based on corresponding preoperative parts.

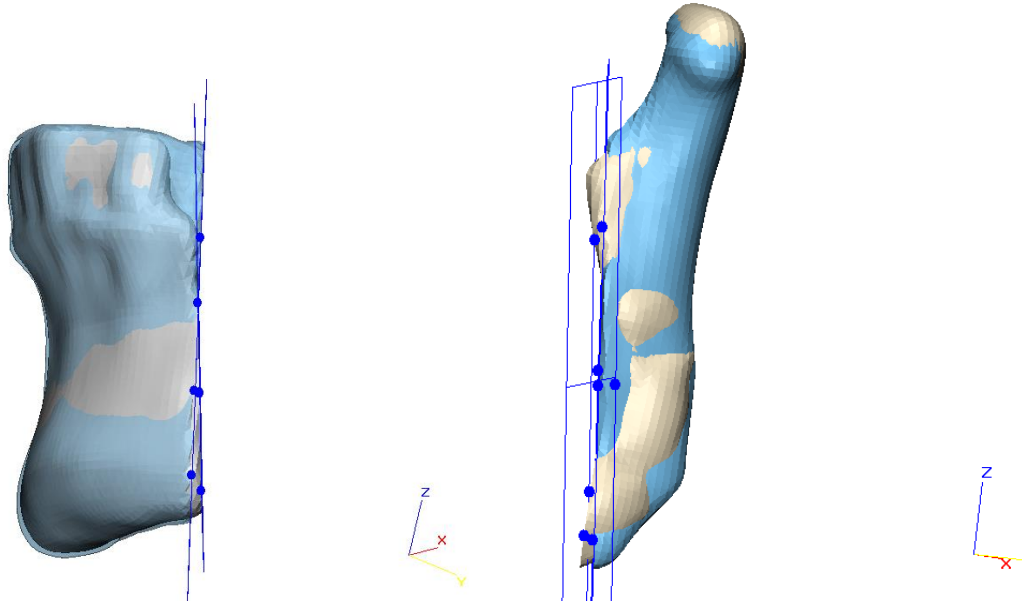
When measuring osteotomy deviations, mandible stumps and bone grafts are superimposed to their corresponding preoperative parts separately.



Category: osteotomy deviations.

Distance deviation of mandibular osteotomy

Angular deviation of mandibular osteotomy



Input Points:

Preoperative virtually-planned mandible				Postoperative reconstructed mandible			
Operated Side				Operated Side			
Absolute deviation of mandible stump	Mean	SD	RMS	Mandible osteotomy plane (MOP)	x	y	z
Mandible osteotomy plane (MOP)				Point A	161.6738	91.2588	101.6334
Point A				Point B	163.1873	92.5874	83.4064
Point B				Point C	160.9999	95.8383	61.8158
Point C				Center point of mandible osteotomy plane (Cmop)	161.3002	93.589	81.4516
Center point of mandible osteotomy plane (Cmop)				Point A	161.6166	90.44	99.8401
				Point B	164.1608	93.1909	67.9753
				Point C	158.0361	95.8745	62.0532
				Center point of mandible osteotomy plane (Cmop)	161.7835	95.8168	81.8726
Non-operated Side				Non-operated Side			
Absolute deviation of mandible stump	Mean	SD	RMS	Mandible osteotomy plane (MOP)	x	y	z
Mandible osteotomy plane (MOP)				Point A	126.4935	39.7447	60.753
Point A				Point B	121.2607	46.6446	44.5239
Point B				Point C	128.9027	45.0491	32.1254
Point C				Center point of mandible osteotomy plane (Cmop)	125.1381	44.6746	43.1726
Center point of mandible osteotomy plane (Cmop)				Point A	123.6834	42.9986	53.9811
				Point B	123.6434	46.1823	43.6298
				Point C	130.0715	46.209	30.4258
				Center point of mandible osteotomy plane (Cmop)	125.7459	45.0392	43.0649

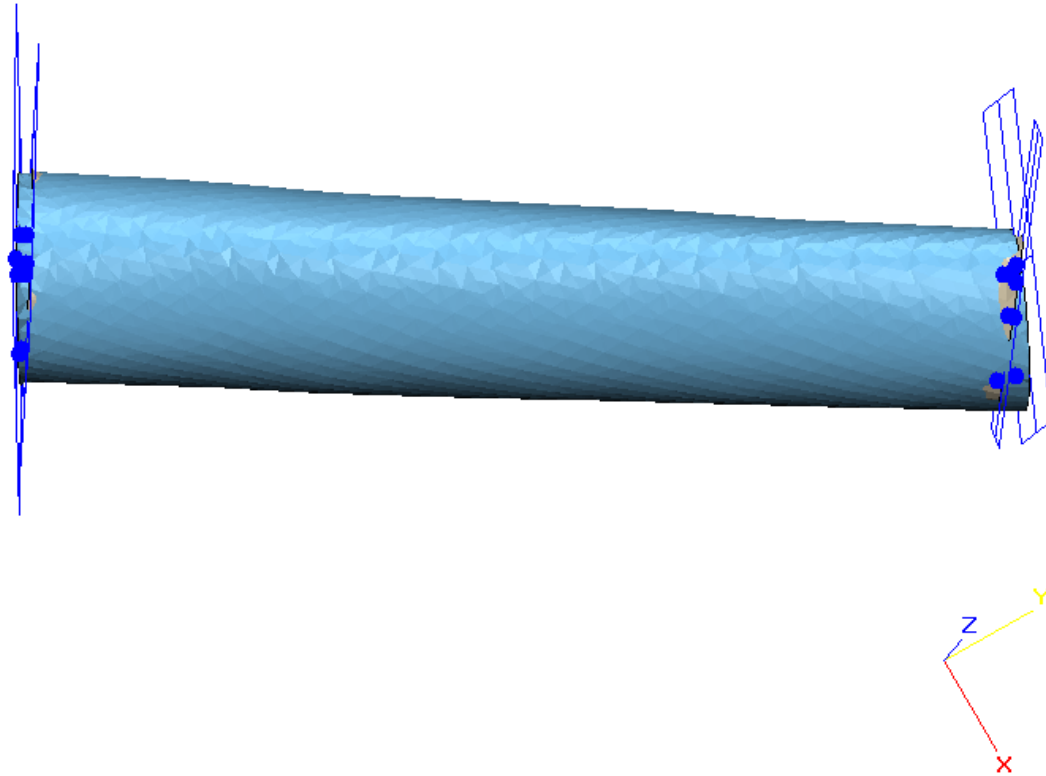
Output Data:

Mandibular Osteotomy			
Operated Side		Non-operated Side	
Distance Deviation (mm)	Angular Deviation (°)	Distance Deviation (mm)	Angular Deviation (°)
2.3181701	4.619422	0.7169054	3.2173684

Category: osteotomy deviations.

Distance deviation of bone graft osteotomy

Angular deviation of bone graft osteotomy



Input Points:

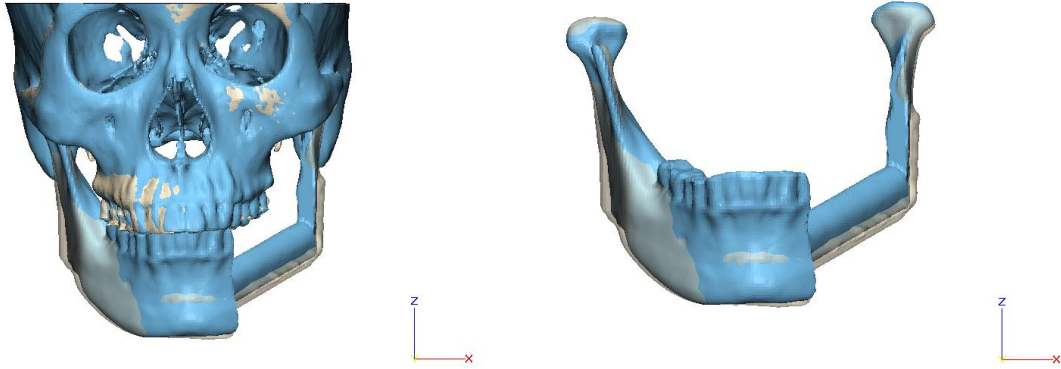
Preoperative virtually-planned mandible				Postoperative reconstructed mandible			
Bone graft_s1 distal osteotomy plane (BOP_s1_distal)				Bone graft_s1 distal osteotomy plane (BOP_s1_distal)			
Point A	157.3359	94.6978	70.9008	Point A	158.3331	93.961	71.4259
Point B	156.6909	96.0453	61.7433	Point B	156.8549	96.5376	62.0936
Point C	162.7352	93.4359	61.9256	Point C	162.4573	92.0951	62.7049
Center point of bone graft_s1 distal osteotomy plane (Cbop_s1_distal)				Center point of bone graft_s1 distal osteotomy plane (Cbop_s1_distal)			
	159.6806	94.3235	65.5174		159.5103	93.8417	66.237
Bone graft_s1 mesial osteotomy plane (BOP_s1_mesial)				Bone graft_s1 mesial osteotomy plane (BOP_s1_mesial)			
Point A	124.8115	43.7214	51.1534	Point A	125.4364	44.211	51.023
Point B	129.4905	42.9143	43.0239	Point B	129.1873	43.5857	41.6472
Point C	122.7591	47.4618	40.5921	Point C	123.0048	47.4721	42.0393
Center point of bone graft_s1 mesial osteotomy plane (Cbop_s1_mesial)				Center point of bone graft_s1 mesial osteotomy plane (Cbop_s1_mesial)			
	125.3894	44.4708	46.6058		125.5709	45.0369	46.2125

Output Data:

Bone Graft Osteotomy															
Bone Graft_s1				Bone Graft_s2				Bone Graft_s3				Bone Graft_s4			
Distal Side		Mesial Side		Distal Side		Mesial Side		Distal Side		Mesial Side		Distal Side		Mesial Side	
Distance Deviation (mm)	Angular Deviation (°)	Distance Deviation (mm)	Angular Deviation (°)	Distance Deviation (mm)	Angular Deviation (°)	Distance Deviation (mm)	Angular Deviation (°)	Distance Deviation (mm)	Angular Deviation (°)	Distance Deviation (mm)	Angular Deviation (°)	Distance Deviation (mm)	Angular Deviation (°)	Distance Deviation (mm)	Angular Deviation (°)
0.8825857	14.565261	0.7128088	3.3498465	0	#DIV/0!	0	#DIV/0!	0	#DIV/0!	0	#DIV/0!	0	#DIV/0!	0	#DIV/0!

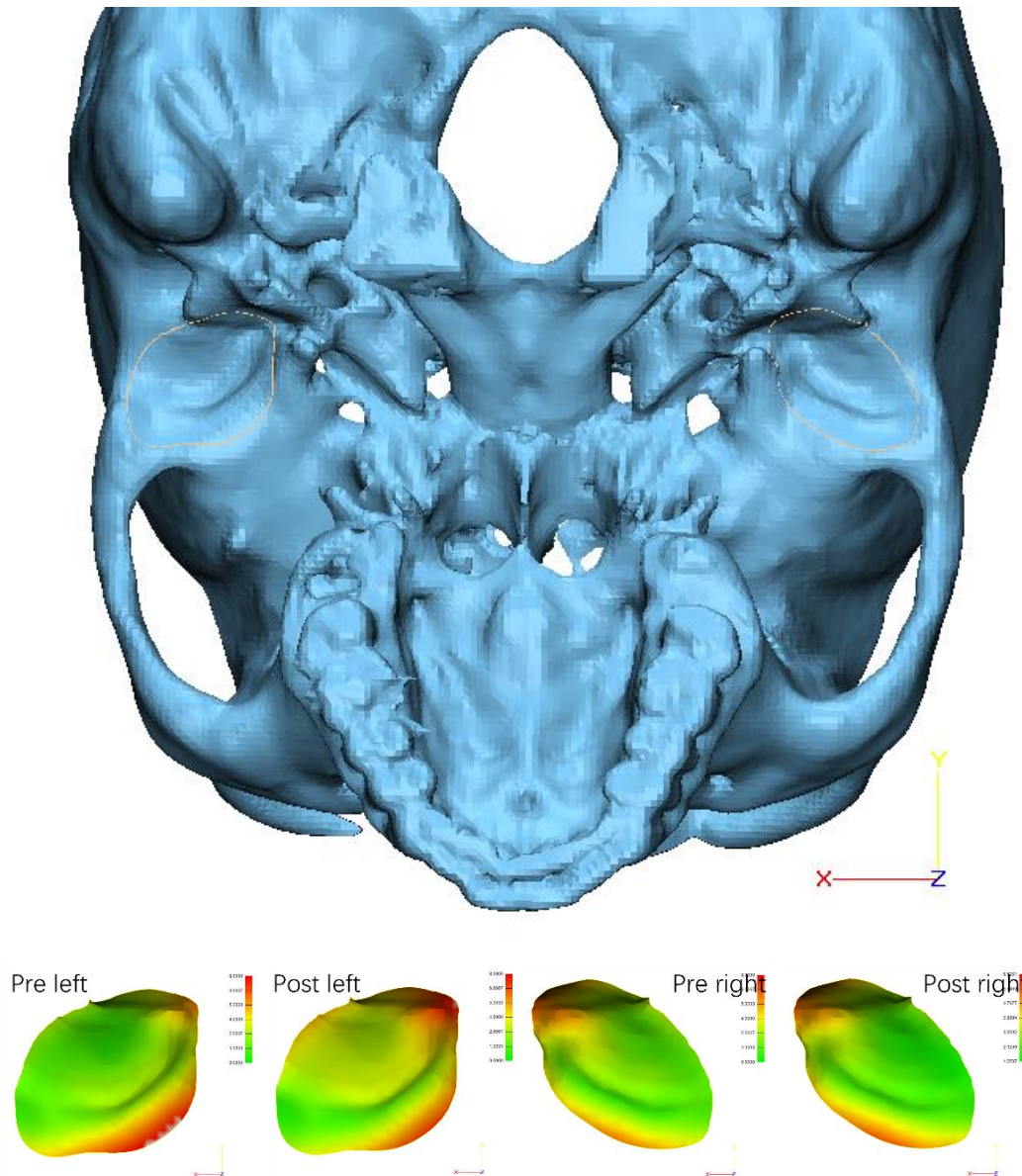
Superimposition based on maxilla.

When measuring condylar deviations, mandibles are superimposed based on maxillae, and therefore condylar deviations can be evaluated in the physiological condition.



Category: condylar deviations.

Absolute deviation of TMJ joint space

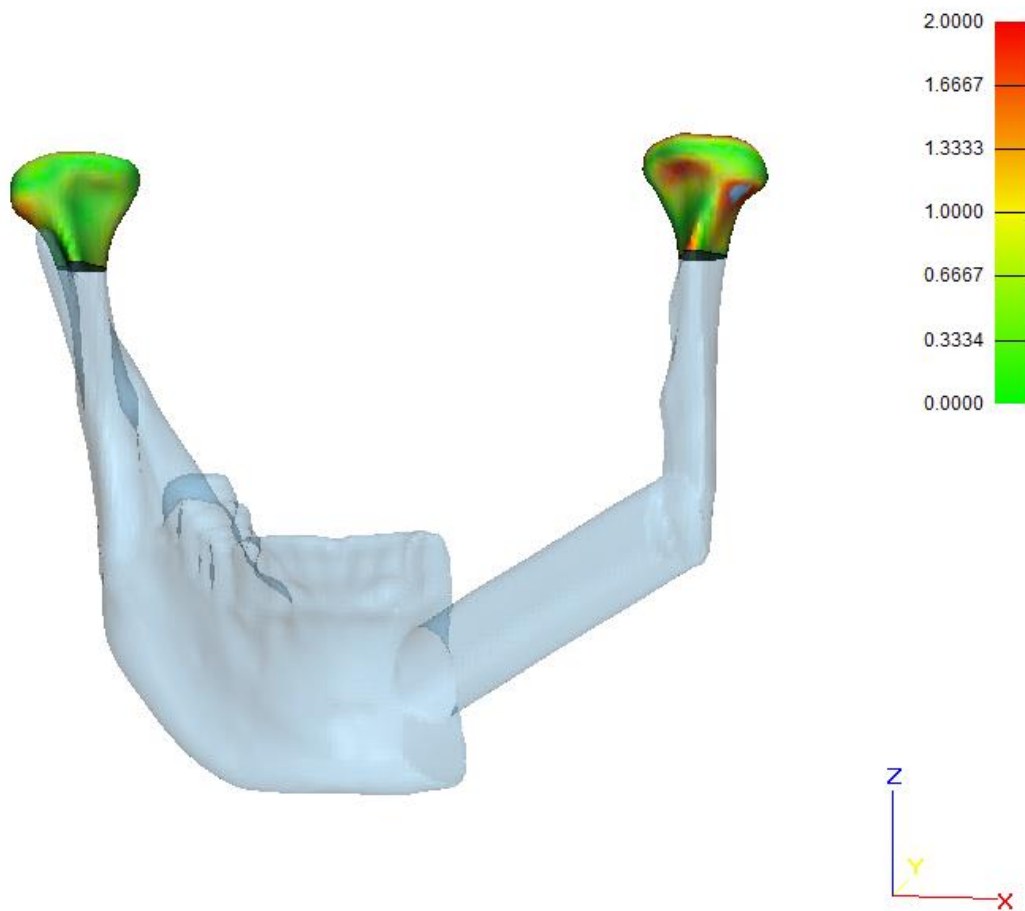


Output Data:

TMJ Joint Space (mm)													
Operated Side							Non-operated side						
Pre-			Post-			Distance Deviation (mm)	Pre-			Post-			Distance Deviation (mm)
Mean	SD	RMS	Mean	SD	RMS		Mean	SD	RMS	Mean	SD	RMS	
4.0986	2.043	4.5795	4.4781	1.7687	4.8147	0.3795	4.0288	1.5381	4.3124	4.0008	1.891	4.4251	0.028

Category: condylar deviations.

Absolute deviation of condylar head



Output Data:

Absolute Deviation of Condylar Head (mm)					
Operated Side			Non-operated Side		
Mean	SD	RMS	Mean	SD	RMS
1.0042	0.6554	1.199	0.4811	0.3147	0.5748

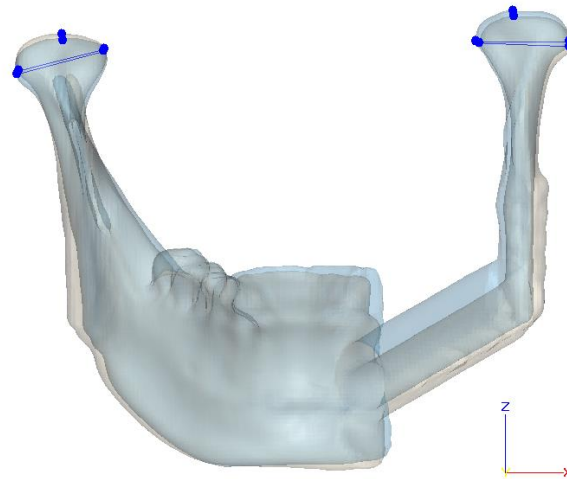
Category: condylar deviations.

Spatial shifts of condylion

Spatial shifts of lateral pole of condyle

Spatial shifts of medial pole of condyle

Angular deviation of condylar head



Input Points:

Preoperative virtually-planned mandible				Postoperative reconstructed mandible			
Operated Side				Operated Side			
	x	y	z		x	y	z
Condylion (Co)	160.9415	99.2741	130.837	Condylion (Co)	161.1254	98.5132	129.6906
Lateral pole of condyle (Clp)	174.041	98.4153	123.7711	Lateral pole of condyle (Clp)	174.108	96.1655	122.6545
Medial pole of condyle (Cmp)	152.2423	104.3742	123.8551	Medial pole of condyle (Cmp)	153.1781	102.3312	123.4888
Gonion (Go)	163.9985	105.566	70.438	Gonion (Go)	166.8945	102.5967	76.348
Inferior point of mental tubercle (Mt)				Inferior point of mental tubercle (Mt)			
Non-operated Side				Non-operated Side			
	x	y	z		x	y	z
Condylion (Co)	56.5142	96.6184	124.138	Condylion (Co)	56.3754	97.7632	125.4972
Lateral pole of condyle (Clp)	45.9576	95.7623	116.2622	Lateral pole of condyle (Clp)	46.3754	96.36	117.0568
Medial pole of condyle (Cmp)	66.06	100.5419	121.5868	Medial pole of condyle (Cmp)	66.2555	101.474	122.0568
Gonion (Go)	63.2603	103.2299	57.4665	Gonion (Go)	63.2603	103.2299	57.4665
Inferior point of mental tubercle (Mt)				Inferior point of mental tubercle (Mt)			

Output Data:

Spatial Shifts of Condylion (mm)							
Operated Side				Non-operated Side			
3D	A-P	S-I	M-L	3D	A-P	S-I	M-L
1.3881718	0.7609	1.1464	0.1839	1.7824862	1.1448	1.3592	0.1388

Spatial Shifts of Lateral Pole (mm)				Spatial Shifts of Medial Pole (mm)			
Operated Side		Non-operated Side		Operated Side		Non-operated Side	
3D	A-P	S-I	M-L	3D	A-P	S-I	M-L
2.5125454	2.2498	1.1166	0.067	1.0785135	0.5977	0.7946	0.4178
2.2767842	2.043	0.3863	0.9358	1.0620408	0.9321	0.47	0.1955

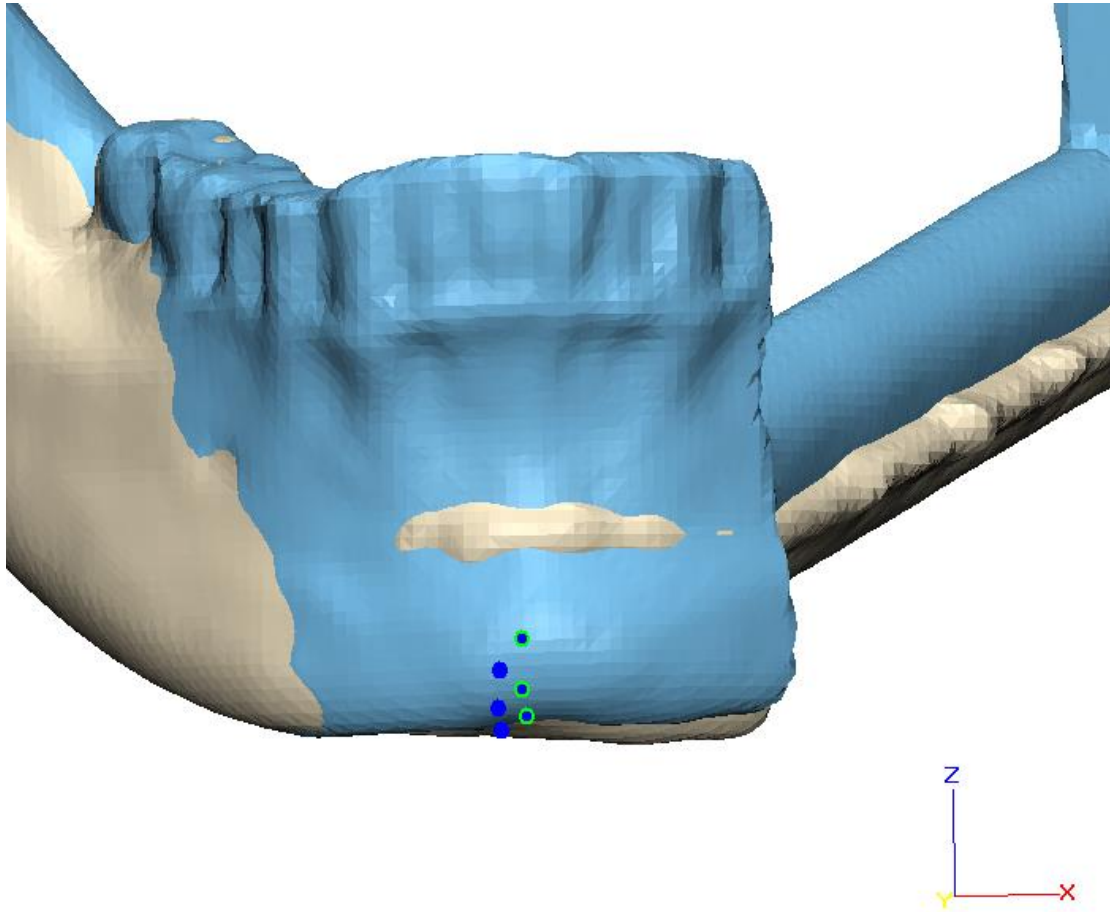
Angular Deviation of Condylar Head (°)							
Operated Side				Non-operated Side			
Sectional	Coronal	Sagittal	3D	Sectional	Coronal	Sagittal	3D
1.1254733	2.06191	6.8984454	2.2745705	1.051647	0.7179503	3.7332084	1.2725483

Category: midline deviations.

Spatial shifts of menton

Spatial shifts of gnathion

Spatial shifts of pogonion



Input Points:

Preoperative virtually-planned mandible				Postoperative reconstructed mandible			
	x	y	z		x	y	z
Menton (Me)	110.6171	39.2643	26.3391	Menton (Me)	108.8299	43.3087	25.3078
Gnathion (Gn)	110.1977	35.8488	28.4811	Gnathion (Gn)	108.3754	38.7073	27.0568
Pogonion (Po)	110.1538	34.1038	32.5098	Pogonion (Po)	108.3754	36.6709	30.0568

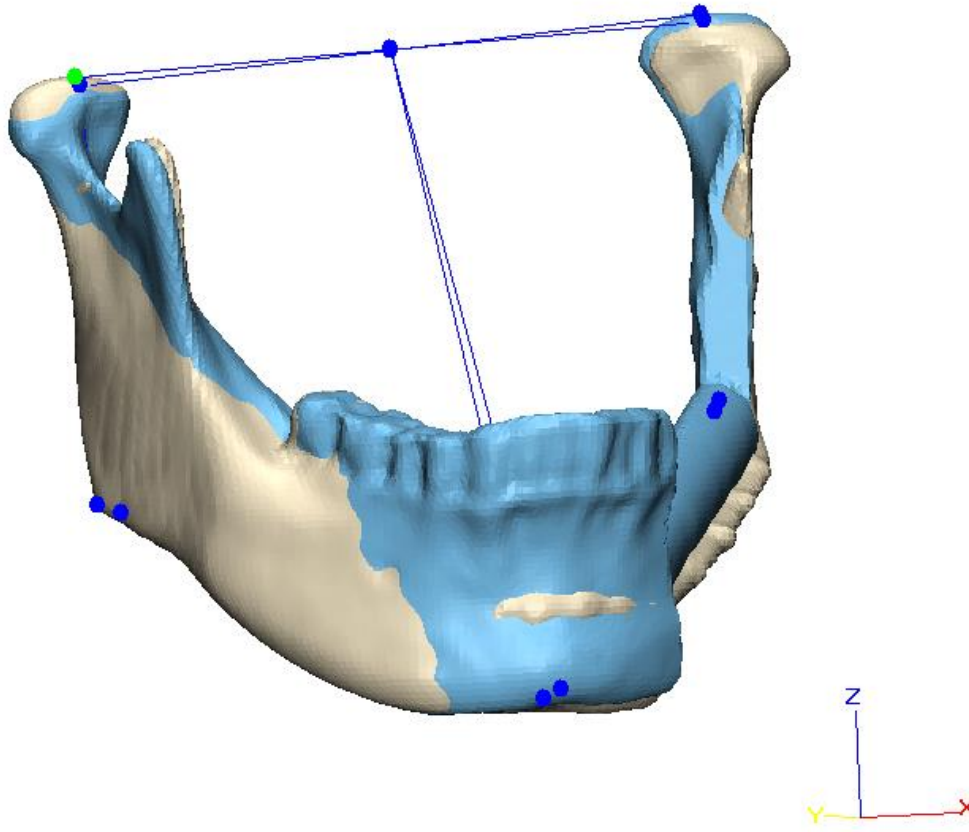
Output Data:

Midline Points											
Spatial Shifts of Menton (mm)				Spatial Shifts of Gnathion (mm)				Spatial Shifts of Pogonion (mm)			
3D	A-P	S-I	M-L	3D	A-P	S-I	M-L	3D	A-P	S-I	M-L
4.5403563	4.0444	1.0313	1.7872	3.6770137	2.8585	1.4243	1.8223	3.9711356	2.5671	2.453	1.7784

Category: miscellaneous.

Distance deviation of slant length of neomandible

Distance deviation of ramal height



Input Points:

Preoperative virtually-planned mandible				Postoperative reconstructed mandible			
	x	y	z		x	y	z
Pogonion (Po)	110.1538	34.1038	32.5098	Pogonion (Po)	108.3754	36.6709	30.0568
Operated Side				Operated Side			
Condylion (Co)	160.9415	99.2741	130.837	Condylion (Co)	161.1254	98.5132	129.6906
Gonion (Go)	163.9989	105.5664	70.438	Gonion (Go)	164.3754	108.7632	68.701
Non-operated Side				Non-operated Side			
Condylion (Co)	56.5142	96.6184	124.138	Condylion (Co)	56.3754	97.7632	125.4972
Gonion (Go)	63.2652	103.1296	57.3204	Gonion (Go)	58.3754	100.7632	58.7048

Output Data:

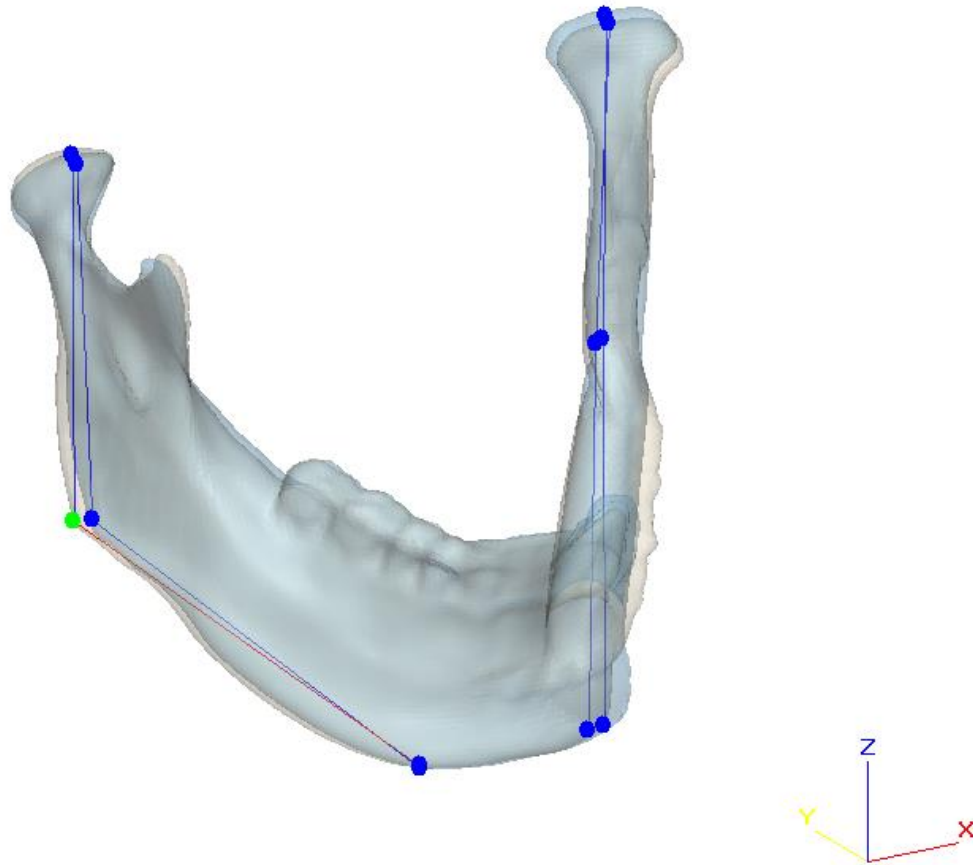
Slant Length of Neomandible (mm)			Ramal Height (mm)					
			Operated Side			Non-operated Side		
Pre-	Post-	Distance Deviation	Pre-	Post-	Distance Deviation	Pre-	Post-	Distance Deviation
116.87823	116.7899	0.0883305	60.802795	61.930254	1.1274581	67.472686	66.889646	0.5830406

Category: miscellaneous.

Angular deviation of frontal ramal inclination

Angular deviation of lateral ramal inclination

Angular deviation of axial mandibular angle



Input Points:

Preoperative virtually-planned mandible				Postoperative reconstructed mandible			
Operated Side				Operated Side			
	x	y	z		x	y	z
Condylion (Co)	160.9415	99.2741	130.837	Condylion (Co)	161.1254	98.5132	129.6906
Gonion (Go)	163.9989	105.5664	70.438	Gonion (Go)	164.3754	108.7632	68.701
Inferior point of mental tubercle (Mt)	129.2568	44.9057	26.7134	Inferior point of mental tubercle (Mt)	128.3754	48.7632	24.9092
Non-operated Side				Non-operated Side			
	x	y	z		x	y	z
Condylion (Co)	56.5142	96.6184	124.138	Condylion (Co)	56.3754	97.7632	125.4972
Gonion (Go)	63.2652	103.1296	57.3204	Gonion (Go)	58.3754	100.7632	58.7048
Inferior point of mental tubercle (Mt)	94.0464	46.1877	25.2944	Inferior point of mental tubercle (Mt)	94.3754	48.7632	25.4022

Output Data:

Frontal Ramal Inclinations (°)				Lateral Ramal Inclinations (°)				Axial Mandibular Angles (°)			
Operated Side		Non-operated Side		Operated Side		Non-operated Side		Operated Side		Non-operated Side	
Pre-	Post-	Angular Deviation	Pre-	Post-	Angular Deviation	Pre-	Post-	Angular Deviation	Pre-	Post-	Angular Deviation
2.8978414	3.0502795	0.1524381	5.7893722	1.7151252	4.054247	5.9475552	9.5400593	3.5925042	5.5657505	2.5717281	2.9940224
29.800988	30.983757	1.1627682	28.394417	33.690068	5.2856507						