28th Annual Meeting of the AANS/CNS Section on Disorders of the Spine and Peripheral Nerves
Walt Disney World Swan and Dolphin
Orlando, Florida
March 7 - 10, 2012

The Naso-Axial Line: A New Method of Accurately Predicting the Inferior Limit of the Endoscopic Endonasal Approach to the Craniocervical Junction

Philipp R. Aldana MD FAAP; Emanuele La Corte MS3
University of Florida Health Science Center-Jacksonville, Florida (PRA) and San Paolo Medical School, University of Milan, Italy (ELC)

Introduction

The endoscopic endonasal approach (EEA) has developed as an emerging surgical corridor to the craniovertebral junction (CVJ). An important limitation of the EEA to the CVJ is the caudal exposure limited by the bony and soft tissues of the nose superiorly, and by the hard palate inferiorly. In addition to understanding its indications and surgical anatomy, the ability to predict its inferior limit is vital for optimal surgical planning

The objective of this anatomic-radiologic study was to develop a method that accurately predicts the inferior limit of the EEA on the CVJ radiologically and to compare this to other currently used methods.

Methods

Pre-dissection CT scans of nine cadaver heads were used to delineate a novel line, the naso-axial line (NAxL), to predict the inferior EEA limit on the upper cervical spine. A previously described method using the nasopalatine line (NPL) (or Kassam line) was also employed. Using the EEA, maximal inferior bony resection was performed on the upper cervical spine. On CT scans obtained following dissection of the EEA, the predicted inferior limits were compared to the actual extent of dissection.

Results

Radiographic References:

Using the sagittal reconstructions of the head CT images, the following lines were constructed:

NASO-AXIAL LINE. The line is constructed in the midsagittal plane by using a starting point that corresponds to the midpoint of the distance from rhinion (the most inferior point of the internasal suture) to the anterior nasal spine of the maxillary bone and a second point at the tip of the posterior nasal spine of palatine bone. It is then extended posteriorly and inferiorly to end at the C2 vertebra. (Figures 1)

NASOPALATINE LINE. The line created by connecting the most inferior point of the nasal bone to the posterior edge of the hard palate in the midsagittal plane (Figure 1).

Comparison of inferior limits predicted vs. actual surgical dissection:

The post-dissection inferior EEA limit ranged from the dens tip to upper half of the C2 body, which matched the limit predicted by NAxL, with no statistically significant difference between them. In contrast to the NAxL, the NPL predicted a significantly lower EEA limit ($P<0.001$), ranging from the lower half of the C2 body to the superior endplate of C3 (Figure 2).

Conclusions

The naso-axial line predicts the inferior limit of the EEA, which ranges from the dens to the upper half of C2, more accurately than the NPL. This method, which can be easily used on preoperative sagittal scans, accounts for variations in patients' anatomy and can aid surgeons in the assessment of the EEA to address caudal CVJ pathology.

Learning Objectives

By the conclusion of this session, the particpants should be able to: 1) Describe the anatomical structures that limit the inferior extent of the endoscopic endonasal approach to the CVJ. 2) Describe the method of using the naso-axial line in predicting the lower limit of the EEA to the CVJ. 3) Be comfortable in using the NAxL method in everyday practice.

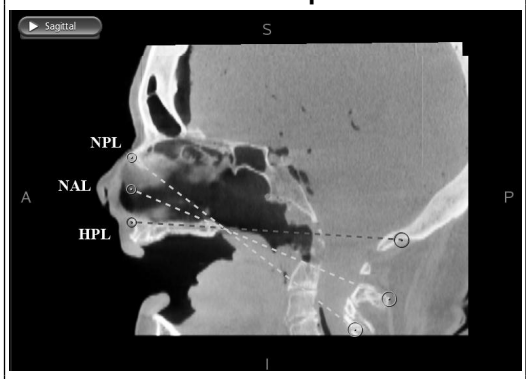
References

1. Cavallo LM, Messina A, Cappabianca P, Esposito F, de Divitiis E, Gardner P, Tschabitscher M. Endoscopic endonasal surgery of the midline skull base: anatomical study and clinical considerations. Neurosurg Focus. 2005 Jul 15; 19 (1) :E2. PubMed PMID:16078816.

2. Cavallo LM, Cappabianca P, Messina A, Esposito F, Stella L, de Divitiis E, Tschabitscher M. The extended endoscopic endonasal approach to the clivus and cranio-vertebral junction: anatomical study. Childs Nerv Syst. 2007 Jun; 23 (6) :665-71. PubMed PMID:17415571.

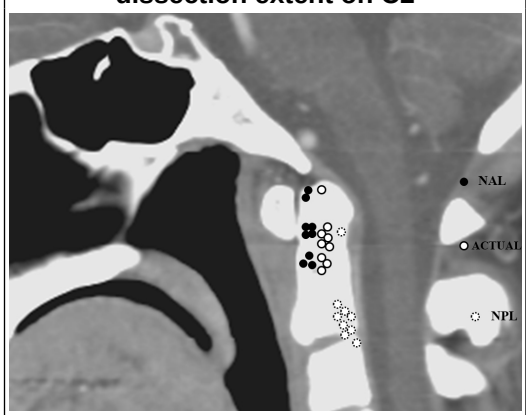
3. de Almeida JR, Zanation AM, Snyderman CH, Carrau RL, Prevedello DM, Gardner PA, Kassam AB. Defining the nasopalatine line: the limit for endonasal surgery of the spine. Laryngoscope. 2009 Feb; 119 (2) :239-44. PubMed PMID:19172603.

Fig 1. Comparing dissection extent, naso-axial and nasopalatine lines



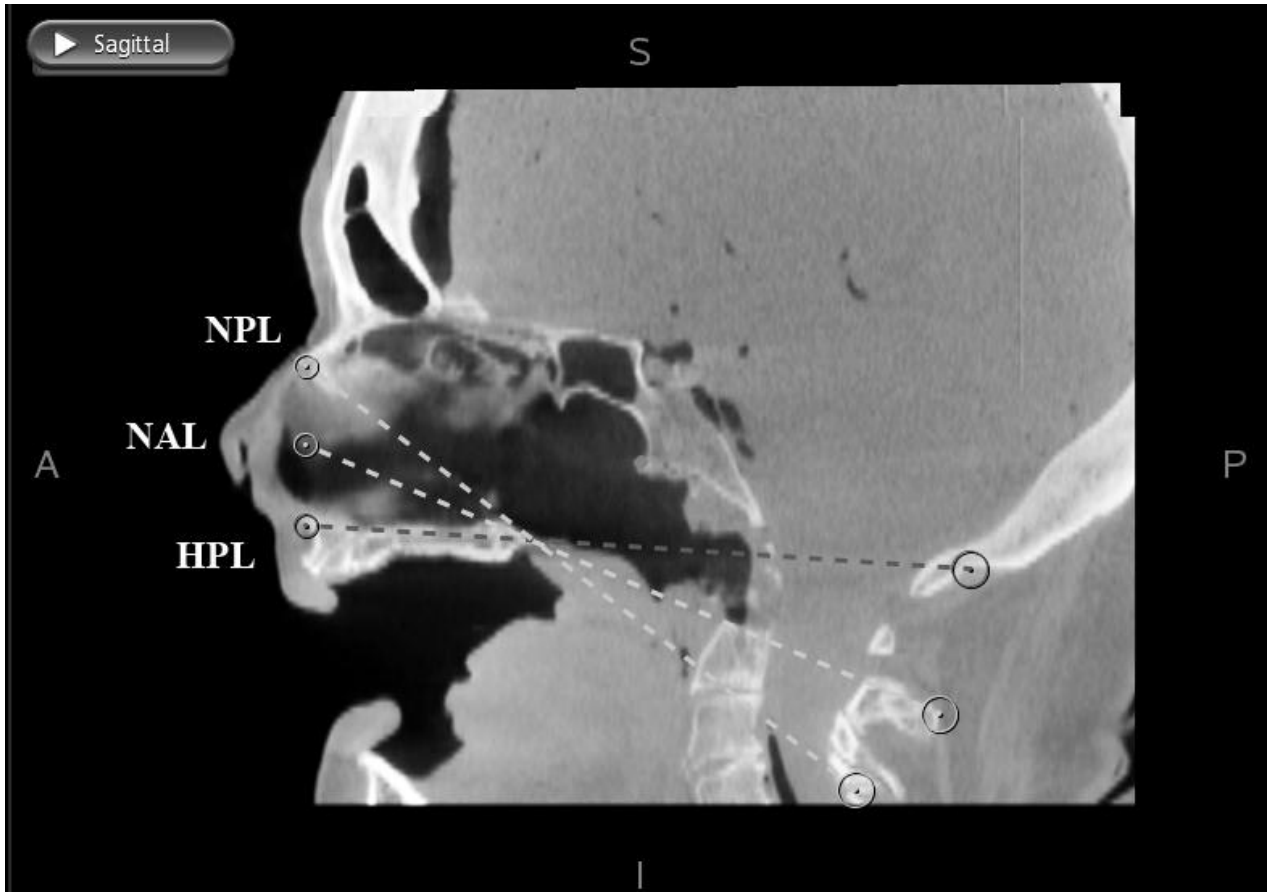
Post dissection CT showing the naso-axial line (NAL), nasopalatine line (NPL), or Kassam line. Also shown is the hard palate line (HPL), which serves as the reference line when comparing the NAL and NPL.

Fig 2. Termination of NAL, NPL and dissection extent on C2



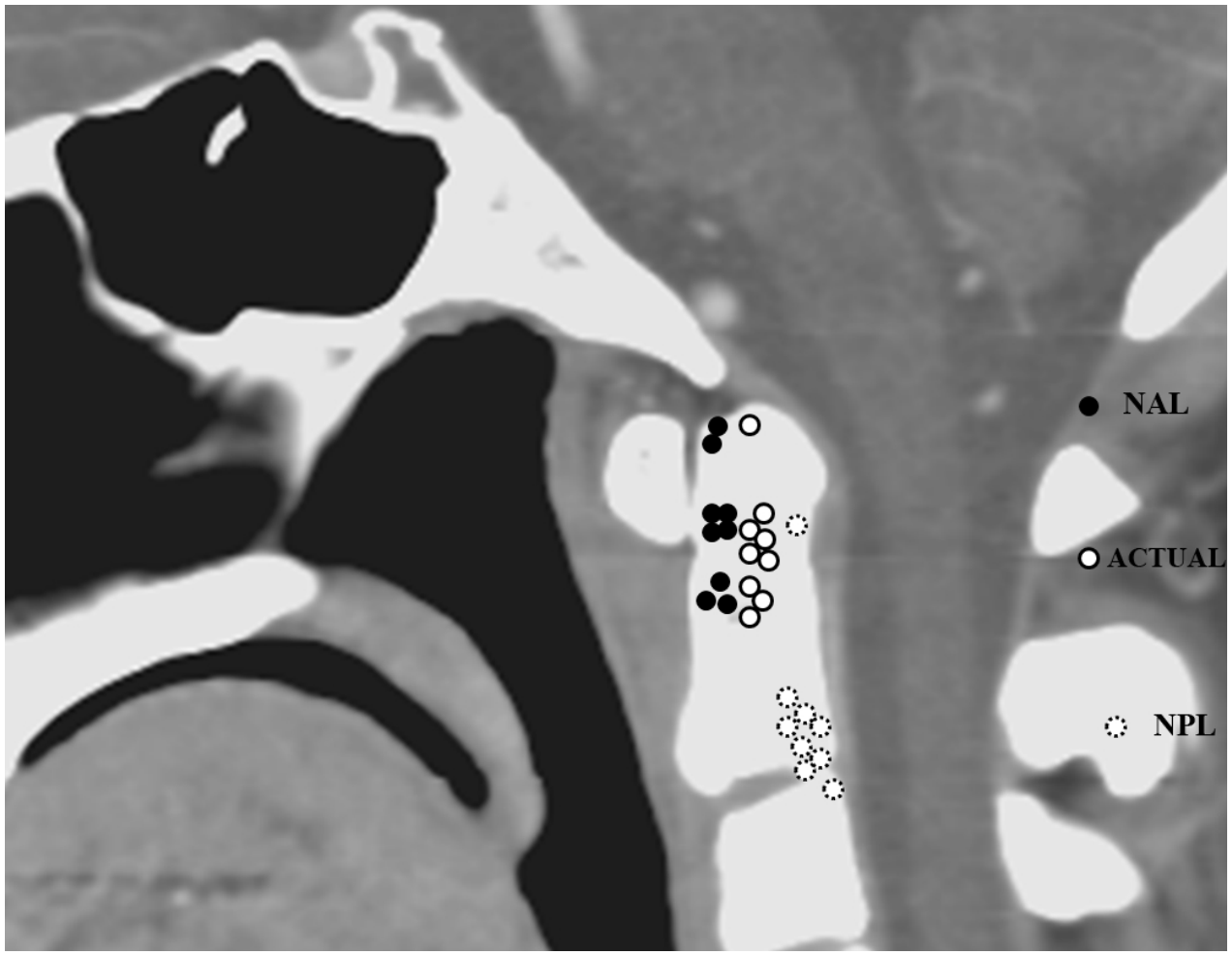
The inferior extent of dissection ranged from the tip to the upper 1/2 of C2, which matched that predicted by the NAL. The NPL predicted much lower range of EEA inferior limit - the lower 1/2 of the C2 body to C3.

Fig 1. Comparing dissection extent, naso-axial and nasopalatine lines



Post dissection CT showing the naso-axial line (NAL), nasopalatine line (NPL), or Kassam line. Also shown is the hard palate line (HPL), which serves as the reference line when comparing the NAL and NPL.

Fig 2. Termination of NAL, NPL and dissection extent on C2



The inferior extent of dissection ranged from the tip to the upper 1/2 of C2, which matched that predicted by the NAL. The NPL predicted much lower range of EEA inferior limit - the lower 1/2 of the C2 body to C3.