Intraoperative Technique to Define the Safe Lateral Limit of Anterior Cervical Corpectomy; A Cadaveric Study
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INTRODUCTION: Loss of anatomical orientation during anterior cervical surgery can lead to eccentric decompression and injury to the vertebral artery. Various anatomic landmarks have been used to achieve safe and adequate decompression: these include a line 3mm lateral to the longus colli insertion1, the lateral limit of the uncovertebral joint2, and the initial posterior curvature of the anterior surface of the vertebral body3. In addition to these anatomical landmarks, the senior author has used an intraoperative radiographic technique to achieve safe wide decompression in patients with altered anatomy. The technique involves placing radiographic contrast material into the corpectomy site and obtaining an intraoperative AP radiograph. In this study, we demonstrate the efficacy of this intraoperative radiographic technique using a cadaveric model.

METHODS: Four cadaveric cervical spine specimens from C2 to C7 were harvested. A “preoperative” AP x-ray and CT scan were performed. The narrowest interforaminal diameter between the vertebral arteries was measured at levels C3, C4, and C5 on the CT scan. The narrowest interuncal diameter (the distance from the peak of the right uncovertebral joint to the left uncovertebral joint) was also measured on plain x-rays at the same levels. Subsequently an 18mm width two level corpectomy was performed using a motorized burr and hand-held curettes. Although the corpectomy site was centered in one control specimen, in the remaining three specimens it was intentionally shifted off center to simulate a surgical error. Each specimen was then analyzed by an “intraoperative” anteroposterior x-ray in which the corpectomy cavity had been filled with 4mL of Conray-240 radio-opaque dye. Measurements were made on these x-rays of the narrowest distance from the dye column to both the right and left uncovertebral joints. Finally a “postoperative” CT scan without dye was performed and the narrowest distance from the corpectomy to both the right and left vertebral arteries was measured.

RESULTS: Analysis of each specimen demonstrated the interforaminal distance determined by “preoperative” CT scan was 23mm to 27mm at C3 and 26mm to 31mm at C5, which agreed with published values.5 These distances were 1mm to 3mm (avg. 2mm) greater than the corresponding interuncal diameter as determined by plain radiographs. Although the 18mm width corpectomy was well within the safe diameter of the interforaminal distance on all specimens, the vertebral artery was lacerated in sample #3 when the
corpectomy was intentionally shifted 3mm lateral to midline. The "intraoperative" dye radiographs indicate the lateral limit of the corpectomy (Figure 1). The distance between the dye column and either the right or left uncovertebral joints was 0mm to 7mm. A “postoperative” CT scan demonstrated the true distance from corpectomy to either right and left vertebral artery was 0mm to 10mm (Figure 2). The accuracy of the AP radiographic measurement as compared to the CT measurement was 82%. More importantly, in all radiographs the measured distance from the “intraoperative” dye column to the uncovertebral joint was less than or equal to the true distance (range 0mm to 8mm, avg. 1.8mm) from corpectomy to vertebral artery as determined by “postoperative” CT scan.

CONCLUSIONS: The surgeon must maintain midline orientation during anterior cervical surgery to achieve proper decompression of the spinal cord and avoid vertebral artery laceration. However, it is possible to become confused by previous surgery or the presence of exuberant osteophytes. We report here an intraoperative radiographic technique to define the lateral limits of the corpectomy in relation to the uncovertebral joints. Although the radiographic technique allows for rotational malalignment, this can be controlled by carefully positioning the neck prior to x-ray. This study demonstrates that the measurement from the dye column to the uncovertebral joint on the contrasted AP radiograph gives an accurate indication of the proximity of the corpectomy to the vertebral artery.

REFERENCES: