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The Use of the Olympus EndoArm for Spinal and Skull-Based Transsphenoidal Neurosurgery

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Summary

Minimally invasive surgical techniques have evolved to reduce soft-tissue injury associated with open surgical techniques. The use of endoscopic visualization allows the exposure of deep structures and provides a mechanism to perform all the components of an open surgical procedure through small portals, thus satisfying a basic requirement of minimally invasive surgical procedures. Surgeons in the field of skull-based and spine surgery are now taking advantage of the benefits of such endoscopes. The pneumatically powered EndoArm endoscopic holder has been used extensively in both cranial and spinal neurosurgical cases at the University of Utah. These cases include minimally invasive cervical and lumbar decompression procedures, as well as more recently for the resection of larger and more extensive pituitary tumors. In this paper, the multiple advantages of the Olympus EndoArm endoscopic holder are described in detail. As more surgeons gain experience with endoscopes in skull-based surgery, the hope is that operative times will be shorter and more extensive surgical resections will be possible with less patient morbidity.

Running Title: Olympus EndoArm Endoscope

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Introduction

Since the introduction of minimally invasive techniques to neurosurgery, many advances have been made in both operative technique and surgical equipment. Minimally invasive surgical approaches have gained popularity in spinal neurosurgery [1] and pediatric neurosurgery [2]. Advances in endoscopes, and the wide application of endoscopy in sinus surgery, have led to the common use of this equipment in anterior skull base and transsphenoidal pituitary surgery [3]. The use of the endoscope has allowed for dramatic improvement in visualization within the entire skull base. In the hands of experienced neurosurgeons, the endoscope ensures that lesions in these areas can be seen much more readily, potentially making surgical intervention safer and less invasive for the patient.

Surgeons using the endoscope for skull base procedures, however, face some minor challenges. Most current endoscopes require the surgeon to hold them with one hand or to have a surgical assistant to hold the endoscope (two- or four-handed techniques). Various systems have been designed recently to overcome this handicap by using articulating arms and high-precision robotic-based stabilizing machines [4]. Although some of these new robotic systems can lock in one position, they are cumbersome and rigid, using standard locking mechanisms that move when tightening or loosening. When working through such a narrow window, millimeters of movement at the wrong time can cause loss of visualization and smudging of the field with blood or debris. Standard locking systems also require two hands to lock the endoscope arm in place when positioned or another sterile surgical hand to make those adjustments intraoperatively. A device that moves with the touch of a button and locks in place with the assistance of a pneumatic clutch mechanism would greatly improve efficiency and precision. We describe the use of the pneumatically powered EndoArm endoscopic holder in skull-based and spine surgery.

Materials and Methods

The Olympus EndoArm endoscope (Olympus Surgical and Industrial America, New York, New York) is an endoscope holder that has a modular construction that includes the base, pillar, grip, articulated arm, counterbalance, and camera head (Fig. 1). The multiple articulations allow for precise positioning of the attached camera and endoscope by use of pneumatic clutches that release with nitrogen gas at a pressure of 100 psi. The maneuvering capabilities range through X, Y, and Z planes and are initiated by depressing the single locking mechanism at the working end of the endoscope arm (Fig. 1). Various endoscopic attachments include 0°, 30°, and 70° degree scopes, which are available in two diameters. The most common diameter for endonasal surgery is 2.7 mm and for spine surgery is 4 mm. The attached endoscope also allows the operator to rotate, zoom, and focus the image (Figs. 1 and 2). The camera uses a single-chip technology for image projection on the viewing screen.

The authors have used this instrument in many cases of endoscopic spinal and anterior skull base procedures. The clutch release mechanism is rapid, which enables quick changes in position. The endoscope is held rigidly with release of the clutch mechanism. The EndoArm has facilitated the use of endoscopic imaging in all of the various MIS procedures attempted to date.

Discussion

The Olympus endoscope in conjunction with the EndoArm articulated pneumatic stand has numerous advantages that encourage its use in skull base and spinal procedures. The base is freely mobile on a rolling stand, enables it to be moved freely in the operating area. Once it is positioned, the endoscope can be secured by using a foot pedal that locks the base in place as with an operating microscope. From the base, a pneumatic arm with several ball-and-socket style joints allows for movement of the endoscope at several points. The fluidity of this endoscope sets it apart from more conventional neurosurgery operative equipment because it does not need continual manual adjustments at each of its joints. A single button locks and releases the pneumatic clutch device and allows for movement in all planes with one hand. Once locked in place, the endoscope does not move until the button is pressed again. This allows for the precise positioning and increased functional use during surgery because it provides the surgeon with two free hands. The endoscope can also be taken deep within the nasal opening to better visualize structures or lesions at the frontal skull base and parasellar regions.

With the removal of large pituitary tumors, or when an extended transsphenoidal operation is required, the endoscope can expand the surgeon's field of view, allowing a virtually panoramic line of sight. The use of the endoscope in transsphenoidal surgery has allowed for more extensive visualization of the frontal skull base and parasellar regions during surgery, making such surgeries safer and more definitive. The drawback to the use of conventional endoscopes has been the cumbersome nature of the equipment, especially the lack of a stabilizing device that is needed to keep the endoscope in place when a good field of view is attained. Until recently, most systems have relied on the surgeon to hold the endoscope with one hand or to use mechanical

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stabilizing device, which were time consuming and difficult to set up. These methods did not give the surgeon the freedom of two operating hands or the ability to move the endoscope freely and re-secure it quickly. The Olympus endoscope eliminates these disadvantages and allows for fluid mobility and rapid locking and unlocking with a push of a button.

The drawback of using most endoscopes for surgical procedures is the two-dimensional view, compared with the three-dimensional view available with a surgical microscope. This is overcome through experience of the surgeon with the endoscope and outweighed by the maneuverability gained with the endoscopic arm. Newer three-dimensional endoscopes have been developed but are larger as the required “interpupillary” distance means that two separate optics or optical chips are needed at the tip to mimic true depth perception. We are in the process of collecting data on our endoscopic procedures and believe that the EndoArm will provide improved efficiency and a reduction in patient morbidity when utilizing an endoscope in both spinal surgeries and in approaches to the anterior cranial base.

Acknowledgments

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References

1. Asgarzadie F, Khoo LT. Minimally invasive operative management for lumbar spinal stenosis: overview of early and long-term outcomes. The Orthopedic clinics of North America 2007;38:387-399; abstract vi-vii
2. Yamini B, Goumnerova LC, Frim DM. Endoscopic approach to noncommunicating fluid spaces in the shunted patient. Pediatric neurosurgery 1999;31:237-241
3. Spencer WR, Das K, Nwagu C, et al. Approaches to the sellar and parasellar region: anatomic comparison of the microscope versus endoscope. The Laryngoscope 1999;109:791-794
4. Nimsky C, Rachinger J, Iro H, Fahlbusch R. Adaptation of a hexapod-based robotic system for extended endoscope-assisted transsphenoidal skull base surgery. Minim Invasive Neurosurg 2004;47:41-46

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Figure Legends

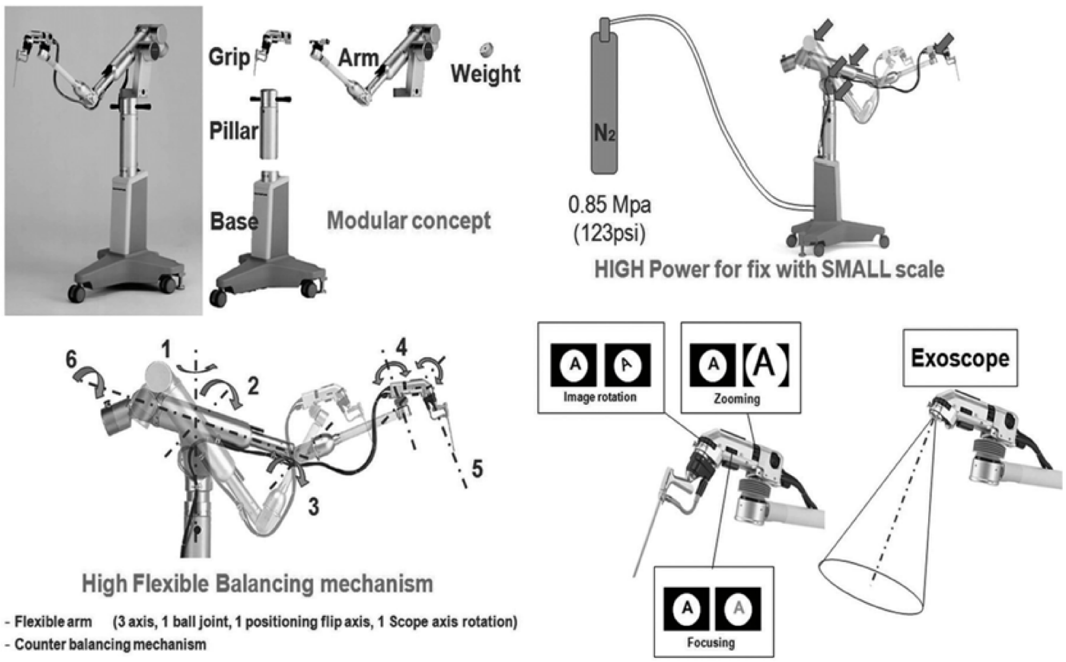

Figure 1. Schematic representation of modular construction of Olympus EndoArm endoscope. The mobile endoscope arm unlocks with a push button operated with one hand through a pneumatically driven power train. Upon release, the flexible arm locks in place, which leaves both of the surgeon’s hands free for operating. The various attachments allow for more options in viewing, including rotation, zooming, and focus of images, all within inches of each other on the endoscope working end.

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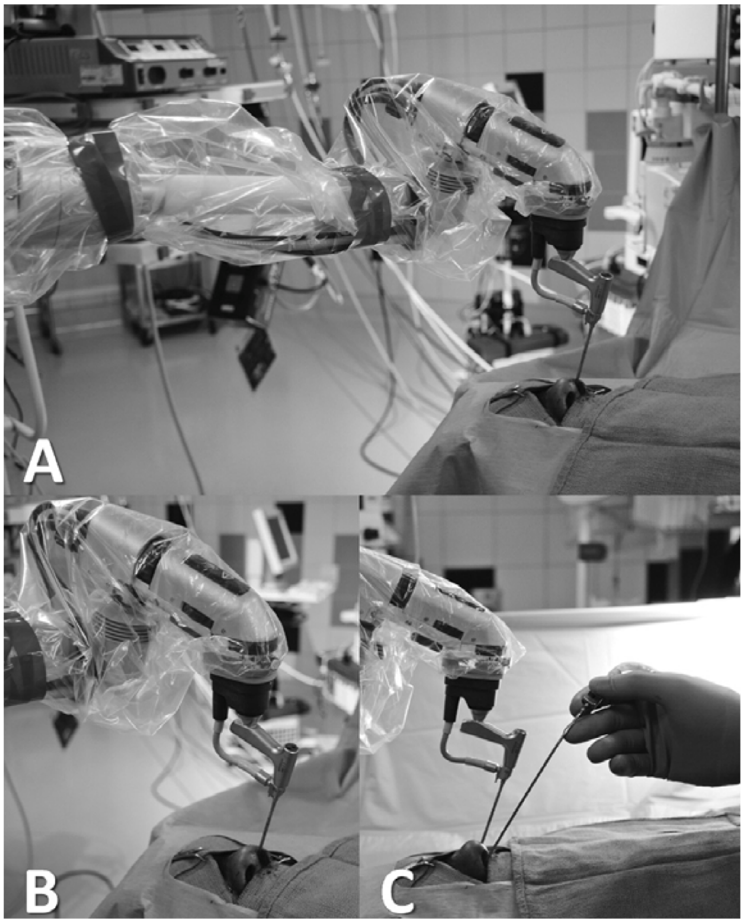

Figure 2. Intraoperative photographs of the Olympus endoscope working arm in a typical position to the sterile field. The surgeon is classically on the right side of the patient. A. The length of the arm allows for considerable room around the surgical site and is sterile along its full length. This allows surgeon mobility about patient. B. View from the surgeon's perspective alongside the patient showing a close-up of the working arm. The buttons to free the endoscope arm are at top. When the release button is not being pushed, the device is securely locked in place. C. Lateral view showing the surgeon placing an instrument (endoscopic suction) within the working port of the endoscope. The clutter-free environment around the surgical site should be noted. No wires, tubes, or extraneous stabilization devices are needed when using this system.