Robotic and Multimodality Endoscopic Endonasal Transsphenoidal Surgery: Preliminary Clinical Application

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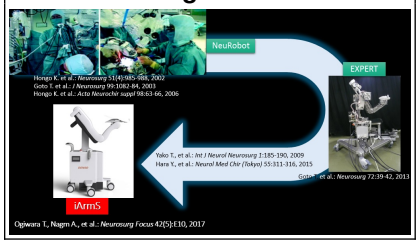
Introduction

Based on our previously published reports on development and applications of robotic technology into microscopic neurosurgical procedures (Fig. 1), we applied the supporting robot (Intelligent Arm Support System "iArmS®") to endoscopic endonasal transsphenoidal surgery (ETSS) and evaluated its early clinical experience.

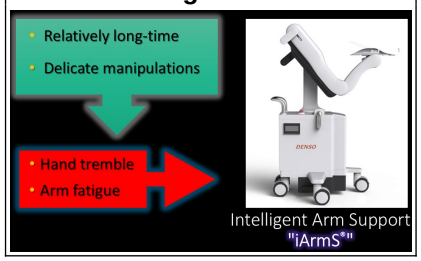
Figure 1



Objectives

In neurosurgery, relatively long-time and delicate manipulations are required, therefore, hand tremble among neurosurgeons is a considerable obstacle. To overcome this problem, we developed the "iArmS" which is a revolutionary motor-less medical robot that can support and maintain the ability of the surgeon's hand during microscopic neurosurgery. It freely follows the movement of the surgeon's arm without switch, and fixes and supports the arm of the practiced hand during manipulations (Fig. 2) (video 1).

Figure 2



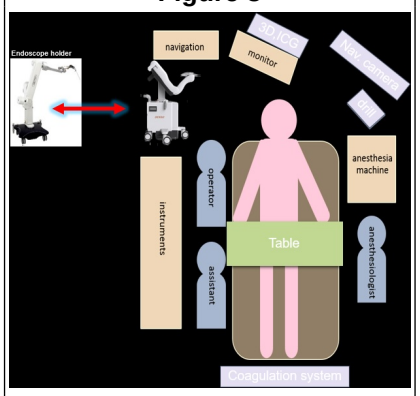
Methods

Herein, 43 patients with sellar region tumors were included (Table 1). Multimodality ETSS [1-3] were applied to all patients. Supporting robot "iArmS" was used to maintain the surgeon's endoscope-holding arm during nasal and sphenoid phases (Fig. 3) (video 1).

Table 1

ETSS	Cases (*total 43*)
pituitary adenoma	29
meningioma	3
Rathke's cleft cyst	3
craniopharyngioma	2
Others (chordomas, metastatic tumors, angiosarcoma, adenoid cystic carcinoma)	6
Sex	
Male	22
Female	21
Age	**16-82 (mean: 52.1) years**

Figure 3



Layout of the operating room

video 1

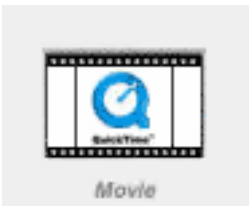


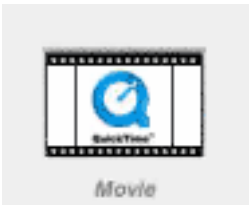
Table 2

	4-hand technique	2 hands with holder	2-hand technique	2 hands with iArmS®
stability of the endoscope	poor	excellent	poor	excellent
operability	good-excellent	poor	excellent	excellent

Results

The iArmS was a valuable tool for stabilizing the surgeon's arm securely and following the surgeon's arm-movement automatically. It decreased surgeon's fatigue and eliminated shaking of the video image by providing a steady surgeon's scope -holding hand. There were no complications relating to the use of iArmS. (Table 2) (video 2).

video 2



ETSS with multimodalities

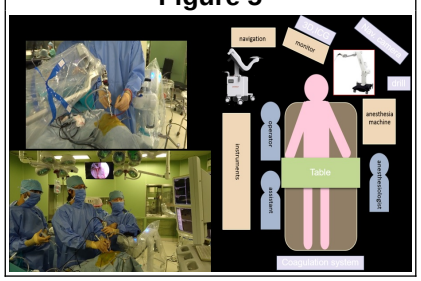
Multimodalities (such as neuronavigation, 3D endoscopy, indocyanine green videoangiography and robot) are necessary in the armamentarium of the neurosurgeon performing ETSS to enhance the surgical results and to prevent surgical complications (Fig. 4) [2].

Figure 4

Issues and solutions

The base of iArmS is large and heavy to prevent it from falling over, in turn the space occupied by the iArmS is a problem. Consideration of the layout of the busy operating room is nessesary (fig 5). Reducing the size of iArmS while maintaining its functionality is our future goal. Addiotionally, the iArmS is too expensive for most institutions; this might inhibit its worldwide adoption. It would be worthwhile to examine its price and running costs [1,3].

Figure 5



Learning Objectives

Robotic technology can become an indispensable modality during ETSS that allows a comfortable surgical environment, and provides a safe surgery based on the delicate manipulations which become available even in such a deep and narrow operative field.

Conclusions

As a novel of this study, the clinical results of robotic ETSS verified that our "iArmS®" is an effective device that improves preciseness and safety. Continued advances in robotics assure continued brisk evolution in neurosurgery.

References

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