TECHNICAL NOTE

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EasyGO!-assisted microsurgical anterior cervical decompression: technical report and literature review

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Introduction

Spinal stenosis is a pathological condition wherein bony, ligamentous and synovial structures of the spine degenerate and overgrow. As the disease progresses, the neural and vascular anatomy of the spinal canal are compressed [1]. Patients experience debilitating pain and reduced muscle strength in their extremities. Disease progression necessitates surgical intervention to prevent irreversible neurological deterioration [2].

Minimally invasive surgery has become a widespread approach to treating pathologies of the spine. Most techniques rely on the endoscope. The introduction of tubular retractors, however, has increased the popularity of minimally invasive surgery among neurosurgeons who lack endoscopic experience. Tubular retractors with wide diameters such as the EasyGO! system provide narrow but sufficient space for bimanual techniques under an operating microscope [3].

Only one previous study has assessed the outcome of a microscopic anterior cervical approach using tubular retractors [3]. We here present our first experience of using the EasyGO! tubular retractor system for an anterior cervical decompression. To the best of our knowledge, this is the first report of an EasyGO!-assisted microscopic anterior approach to the cervical spine.

Case report

A 68-year-old man presented to our department with a two-year history of neck pain radiating into the left hand, accompanied by numbness and significant strength reduction of the left extremity. Conservative therapy had shown no benefit.

Muscle strength was 2/5 in the left upper extremity, predominantly in the biceps and wrist extensors. He had hypoesthesia in his left radial forearm and hand, predominantly in the thumb and index finger. His epicritic and proprioceptive sensations were altered accordingly. Spurling's test was positive. Bicipital, tricipital and Tromner reflexes were all preserved. Abdominal cutaneous reflexes were present. Magnetic resonance imaging and computer tomography of the cervical spine revealed degenerative stenosis of the spinal canal, predominantly at the C5–C6 levels.

Microsurgical decompression at the C5 and C6 segments was indicated (Fig. 1). Neuronavigation was used to localise the site for a minimally invasive access. A linear incision from the midline to the middle of the sternocleidomastoid muscle at the level of the cricoid cartilage was made. Dissection was performed along the anterior edge of the sternocleidomastoid muscle. Then, under constant control of the common carotid artery, access to the anterior surface of the spine was gained.

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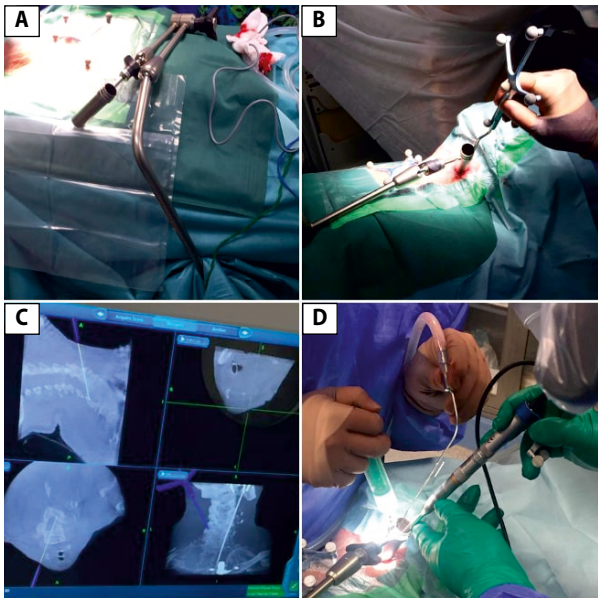

Figure 1. A. EasyGO! tubular retractor was easy to set up; **B., C.** We used neuronavigation to localise ideal site for a minimally invasive trajectory; **D.** Tubular retractor canal offered sufficient exposure for bimanual microsurgical technique

The C5 and C6 vertebral bodies were skeletonised. We then inserted an EasyGO! tubular retractor system (Karl Storz, Tuttingen, Germany). The surgeon can choose between retractors of three different diameters: 15 mm, 19 mm, or 23 mm. We had not made use of an endoscope, relying instead on the use of a binocular operating microscope because our experience with endoscopic surgery was very limited. We therefore chose the EasyGO! tubular retractor with the largest diameter, the one which allowed broad visualisation of the surgical field and convenient bimanual manipulation. Using a high-speed drill, one third of the C5 and C6 vertebral bodies was cut along a diagonal path decompressing the anterior surface of the dura mater. The posterior longitudinal ligament was visualised and removed with a Kerrison rongeur. Autologous bone graft obtained during the dissection was used to stabilise the C5 and C6 vertebrae. Haemostasis was achieved with the help of Surgiflo.

The EasyGO!-assisted microsurgical approach was safe and feasible. We did not experience any complications or technical difficulties. Conversion to a conventional open surgical approach was not considered at any time. The operating time was significantly longer than that of our conventional open procedures.

The patient showed a marked improvement after the first postoperative day. He suffered no neurological alteration, and was discharged on postoperative day three in good clinical condition.

Discussion

Minimally invasive techniques have become increasingly popular due to the minimal disruption of the patient's anatomy. Reduced blood loss and less postoperative pain lead to swifter recovery and discharge. Long-term clinical outcomes may not significantly differ between minimally invasive and open procedures. However, long follow-up data is scarce [4].

Despite the widespread use of endoscopy in spinal surgery, a shallow learning curve must be overcome for safe routine use. Neurosurgeons with little or no experience in endoscopic spinal surgery, such as our group at the time of this report, may thus be hesitant about adopting this technique. The EasyGO! tubular retractor, however, provided a sufficient working canal to perform a bimanual dissection with the help of a binocular microscope [3]. As in any new procedure, operating time was notably longer than that of our open procedures. However, we believe that this increase in operating time may decrease and even become negligible once the learning curve has been overcome. A previous study estimated the number of surgeries necessary to achieve full familiarity with an EasyGO!-assisted microendoscopic procedure as being up to 30 [5].

We further conducted a literature review using the search terms *EasyGO* and *minimally invasive spine surgery* to identify all previous articles on the use of the EasyGO! system. We found eight studies, seven of which described the use of EasyGO! for endoscopic interventions (Tab. 1) [5–12]. The remaining study, conducted by Burkhardt et al. in 2017, compared the image quality between endoscopic and microscopic EasyGO!-assisted surgery [10]. They found their high-definition endoscopic camera allowed more reliable identification of anatomical structures than an operating microscope. All studies have reported very good results regardless of endoscopic or microscopic visualisation. Martin-Láez et al. conducted a large comparative trial to assess the outcomes of EasyGO!-assisted endoscopic discectomy *vs.* a conventional open approach. The EasyGO! group achieved superior results in terms of both average hospital stay (2.4 *vs.* 3.4 days) and symptom relief (90% *vs.* 69%) [5].

We then identified previous reports on anterior approaches to the cervical spine using tubular retractors and conventional microscopy. To our surprise, only one recent study, by Vergara et al., matched our search terms. The group described six cases of anterior cervical discectomy and fusion performed with the help of an operating microscope and the MetrX tubular retractor system (Medtronic) [3]. Though percutaneous insertion of serial dilators is a common technique, the group preferred to perform the dissection under direct microscopic view before inserting the tubular retractor. We used a similar strategy to ensure visual control and avoid neurovascular injury. Angling the retractor allows visualisation of the surrounding anatomy without enlarging the exposure. However, we agree with Vergara et al. that this technique is not suitable for surgery on more than two adjacent segments. We decided to use neuronavigation as an additional modality to increase the safety of our procedure.

The EasyGO! system can help microsurgically-trained neurosurgeons to offer the benefits of a minimally invasive approach using standard bimanual microsurgical techniques.

Table 1. Key findings of studies on use of tubular retractor systems for minimally invasive spinal surgery

Previous reports on use of EasyGO! system for minimally invasive spinal surgery			
Lead author (date of publication)	**Objective**	**Study population**	**Results**
Priola (Mar 2019)	To assess long-term clinical **outcome** of **EasyGO!-assisted percutaneous interlaminar endoscopic sequestrectomy** in lumbar radiculopathy	5 patients were operated with help of EasyGO! system	EasyGO!-assisted surgery was **well-tolerated**; no complications or recurrences noted at 3-year follow-up
Burkhardt (Oct 2019)	To assess **instrument handling** and endoscopic **image quality** in **EasyGO!--assisted spinal decompression**	46 patients (39 x lumbar, 7 x cervical)	EasyGO! system offered **good view** of surgical field and allowed **bimanual decompression** Clinical **success** noted in **85%** of **lumbar** and **100%** of **cervical** cases according to Odoms criteria
Burkhardt (Jul 2017)	To assess **endoscopic** high definition **image quality** in comparison with **conventional microscopic** visualisation in **EasyGO!-assisted posterior lumbar** and **cervical** procedures	A junior resident was required to identify anatomical structures in 13 lumbar and three cervical EasyGO!-assisted surgeries using either endoscopic or microscopic visualisation	**66%** of structures were identified correctly under **endoscopic** view, **41%** under **microscopic** view Endoscopic high-definition camera imaging allowed significantly more reliable identification of anatomical structures
Oertel (Jul 2017)	To describe **EasyGO!-assisted endoscopic intralaminar** approach for **cranially** and **caudally migrated lumbar disc herniations**	31 patients (26 x caudally, 5 x cranially migrated disc herniations)	EasyGO!-assisted endoscopic intralaminar approach was safe **Clinical success** reported in **95%** at mean final follow-up (37 months); Oswestry Disability Index 9%
Oertel (Jul 2017)	To present a series of **lumbar synovial cysts** treated via **EasyGO!-assisted endoscopic approach**	11 patients	**EasyGO!-assisted endoscopic approach** allowed **safe complete removal** while preserving muscle, ligamentous and bony anatomy **82%** of patients reported **excellent** or **good** clinical **outcomes**
Burkhardt (Nov 2016)	To present a series of **cervical osseous foraminal stenosis** treated via **EasyGO!-assisted posterior foraminotomy** and to compare outcomes of **patients with and without previous surgery**	45 patients (20 without previous surgery, 25 with previous surgery)	**Clinical success rate 95%** in patients **without previous surgery**, **75%** in those **with previous surgery** **Reduction in preoperative pain** and **motor recovery** in **100%** of patients **without previous surgery** Reduction in preoperative pain in **92%**, and motor recovery in **67%** of patients **with** previous surgery
Oertel (Jul 2016)	To present a series of **cervical osseous foraminal stenosis** treated via **posterior EasyGO!-assisted endoscopic approach**	43 patients (31 x single-segment, 11 x two-segment, 1 x three-segment decompression)	EasyGO! system was **easy to handle** in all procedures **95% improved** or had no further pain No dural tear or nerve root injury, but one reoperation due to postoperative haematoma
Martín-Láez (Jun 2012)	To compare **EasyGO!-assisted microendoscopic discectomy** to conventional microsurgical discectomy	37 patients in EasyGO! group *vs.* 101 patients in conventional group	**Learning curve** for EasyGO!-assisted surgery overcome after **30th case** Average **hospital stay** in EasyGO! group **2.4 days** *vs.* 3.4 days in conventional group **Symptom relief** in **90%** of patients in EasyGO! group *vs.* **69%** in conventional group **Revision surgery** in **0%** of patients in EasyGO! group *vs.* **10%** in conventional group

Previous reports on use of tubular retractors for anterior cervical spine surgery				
Lead author (Date of publication)	**Objective**	**Study population**	**Reported advantages**	**Reported disadvantages**
Vergara (Nov 2018)	To present a series of minimally invasive **microscope-assisted anterior cervical discectomy and fusion** using **Medtronic MetrX tubular retractors**	6 patients (3 x C3–4, 1 x C5–6, 2 x C5–7)	Minimal tissue disruption Less blood loss Less post-operative pain Shorter hospital stay Better cosmetic result Protection for surrounding structures (carotid, oesophagus, laryngeal nerve)	Increased operative time Steep learning curve Instrument handling and spatial sense difficult in very narrow space Not recommended for more than two-level surgery

Patients may experience better symptom relief with less intraoperative blood loss and soft tissue trauma. Lower rates of reduced muscle strength and less postoperative pain may accelerate patient recovery times and shorten hospital stays. The surgeon can choose between different trocar sizes, the largest of which allows safe bimanual manipulation and the insertion of a high-speed drill. Angling the retractor enables two-segment surgery through the same opening. Similarly, bilateral decompression can be done through a unilateral approach.

Conclusions

We believe that EasyGO! and similar tubular retractors may encourage neurosurgeons with no previous endoscopic experience to use minimally invasive techniques, although a shallow learning curve must be expected. Prospective and comparative studies are needed to demonstrate the potential long-term benefits over conventional microsurgery.

Conflicts of interest: *None.*
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