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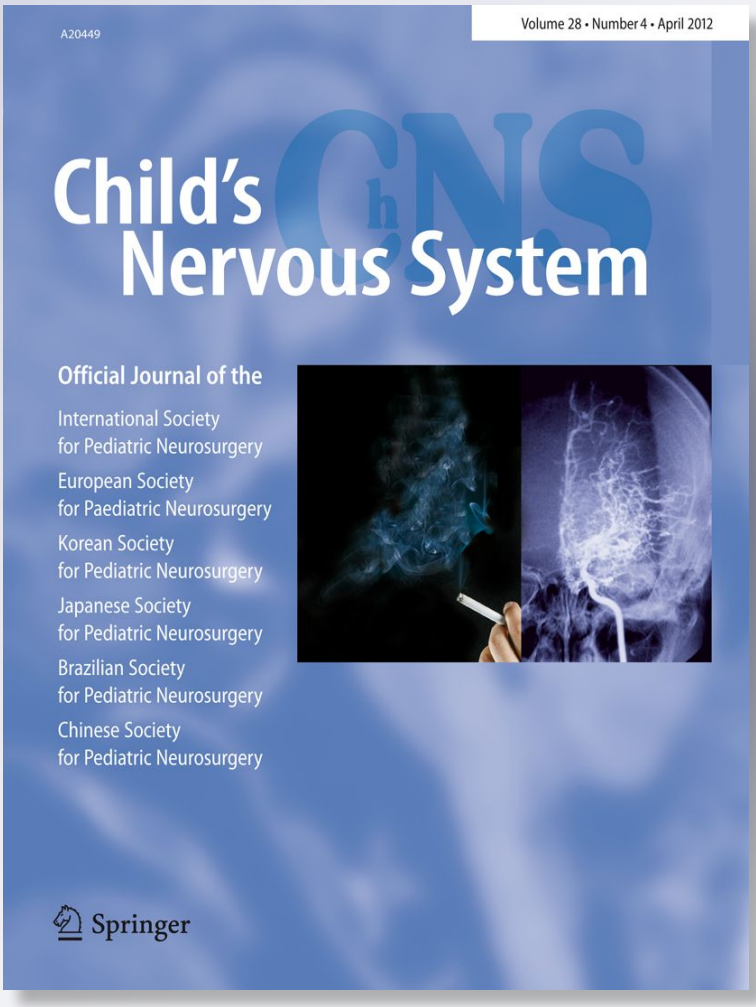
Child's Nervous System

ISSN 0256-7040
Volume 28
Number 4

Childs Nerv Syst (2012) 28:599-604
DOI 10.1007/s00381-012-1720-1



Springer

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ORIGINAL PAPER

Use of the NICO Myriad device for tumor and cyst removals in a developing country

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Received: 20 January 2012 / Accepted: 8 February 2012 / Published online: 25 February 2012

Abstract
Purpose To describe the use of the NICO Myriad, a new side-cutting aspiration device for the resection of tumors, in a developing country.
Methods The 11-, 13-, and 15-ga handpieces were used to resect tumors exposed via craniotomies, and the 19-ga handpiece was used down the side channel of a Storz Oi endoscope to resect tumors exposed endoscopically.
Results The Myriad was used to resect 23 tumors, including spinal cord tumors, posterior fosssa tumors and pineal tumors, and the cysts associated with two craniopharyngiomas. No complications were associated with the Myriad. Handpieces that were re-sterilized in Steranios after the initial use could each be used two to four times thereafter.
Conclusions The Myriad is the first effective tumor removal device that can be introduced down the side channel of most endoscopes, greatly expanding the spectrum of tumors that can be treated endoscopically. Its minimal diameter allows better visibility in small, deep sites such as the pineal region than is usually available when ultrasonic aspirators are used. The cost of the device, and particularly the handpieces, will limit their utility in developing countries until re-usable handpieces are developed.

Keywords Tumor removal · Neuro-endoscopy · NICO Myriad · Developing countries

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Introduction

In most developing countries today, brain tumors, cysts and tissue abnormalities are removed with suction, bipolar cautery, and pituitary forceps, instruments that were used worldwide until the introduction of ultrasonic surgical aspirators in the early 1980s. Since then, ultrasonic surgical aspirators have been the device of choice to remove brain tumors through open craniotomies in developed countries, but their use in developing countries is severely limited by their cost and availability.

In the past 2 years, the NICO Myriad device has become available (Fig. 1). Its handpiece has a high-speed reciprocating sharp inner cannula that is contained within a stationary outer cannula. The device has a directional side window at the distal end of the outer cannula, which also allows the surgeon controlled electronic variable suction. The cutting cannula reciprocates across the window, which is 1.8 mm wide × 1.9 mm long in the outer stationary cannula of the 15-ga (1.9 mm) Myriad device. The window is located 0.6 mm proximal to the distal end of the instrument's outer cannula. The position of the window on the side of the cannula, just proximal to the end of the instrument, allows the surgeon to safely and gently push normal tissue away from the cutting aperture. The window can be rotated by a dial located on the handpiece to provide the desired exposure of the tumor surface to the cutting window in the outer cannula of the device. Intensity of suction can be adjusted by graduated pressure on the foot pedal. The maximum intensity of tissue removal can also be limited, if so desired, by pre-setting a control knob on the instrument console (Fig. 2). Tissue removed by the Myriad is minimally altered by the cutting cannula and is collected in a collection chamber for use in pathological examination.

Fig. 1 An 11-g NICO Myriad handpiece

We have used the Myriad in the Kijabe Hospital, Kijabe, Kenya, in the past 12 months, and report herein our experience using the Myriad in a Third World setting.

Materials and methods

The Myriad console was purchased by The Medtronic Foundation and donated to us. NICO Corporation donated several handpieces of various sizes—11 ga (3.0 mm diameter), 13 ga (2.4 mm diameter), 15 ga (1.9 mm diameter), and 19 ga (1.1 mm diameter). NICO recommends that the handpieces be single use devices, but because few handpieces were available, they were used repeatedly after sterilization in 2% Steranios solution (Anios Corporation) for 1 h after each use.

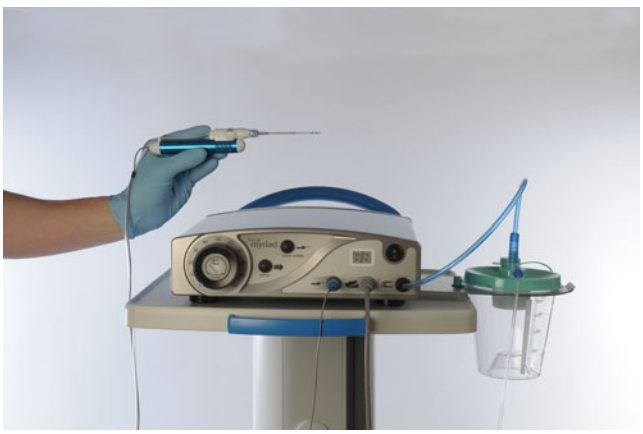

Fig. 2 Myriad console, handpiece, stand, and suction container

The Myriad was used primarily for resections of tissue abnormalities, such as brain and spinal cord tumors and cysts, in both children and adults. The 19-ga Myriad handpiece was used through the side channel of a Storz OI HANDYPRO neuroendoscope in certain cases. This is a significant advancement, as the combination of the Myriad with the Storz OI HANDYPRO (1.2-mm instrument working channel) provides for safe and effective biopsy, as well as resection of tissue abnormalities found in narrow corridors, allowing us to advance minimally invasive neurosurgery in developing countries.

Ethical standards

The human studies described in this manuscript were approved by the Ethics Committee of Kijabe Hospital.

Results and illustrative cases

The Myriad was used to remove one suprasellar pituitary tumor, seven spinal cord tumors, four intraventricular tumors, two hemispheric gliomas, three pineal region tumors, and six posterior fossa tumors, and to resect cysts associated with two craniopharyngiomas. It was also used as an adjunct in the removal of four meningiomas and in two cases of multi-loculated hydrocephalus to convert multiple cavities into a single cavity. Resection times ranged from 1 to 4 h. There were no complications associated with use of the Myriad.

Case 1

An 8-year-old girl presented with chronic headaches of several months duration, with no symptoms of hormonal insufficiency. A computed tomography (CT) scan demonstrated a predominantly cystic, multi-cystic, craniopharyngioma (Fig. 3). Through a burr hole at the coronal suture, the Storz OI neuroendoscope was introduced and advanced into the right lateral ventricle. The dome of the underlying cyst was immediately evident. The 19-ga handpiece was advanced down the side channel of the endoscope and was used to open the cyst wall, aspirate the mucoid cyst contents, and then resect the majority of the cyst walls. The child had no post-operative complications and required no post-operative hormone replacement. Her post-operative CT scan 3 months after operation demonstrated marked reduction in the cystic components of the tumor (Fig. 4).

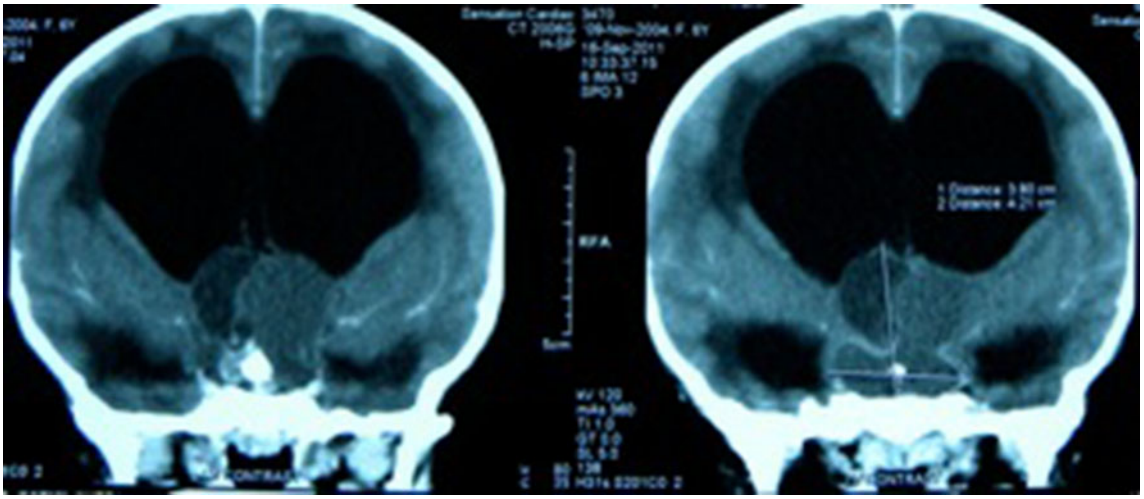

Fig. 3 Pre-operative coronal CT scan demonstrating the multi-cystic craniopharyngioma and associated hydrocephalus

Case 2

A 47-year-old man presented with chronic headaches of several months' duration and had a normal neurological examination. His CT scan demonstrated a 3×4.5 cm intraventricular tumor (Fig. 5). A craniotomy and trans-callosal approach were performed. The tumor was soft, mildly vascular, and was completely resected with the 15-ga Myriad handpiece without complications. A post-operative scan 6 months later demonstrated no hydrocephalus and no residual tumor (Fig. 6).

Case 3

A 24-year-old man presented with a 6-month history of progressive paraparesis. He had antigravity strength only in the lower extremities. His MR scan demonstrated a thoracic intramedullary spinal cord tumor with associated syringomyelia (Fig. 7). An osteoplastic laminotomy was performed and the tumor was resected with the 13-ga Myriad. Post-operatively, his strength gradually improved. One year after operation, he was able to ambulate with the use of a single cane and his MR scan demonstrated no evident residual tumor (Fig. 8).

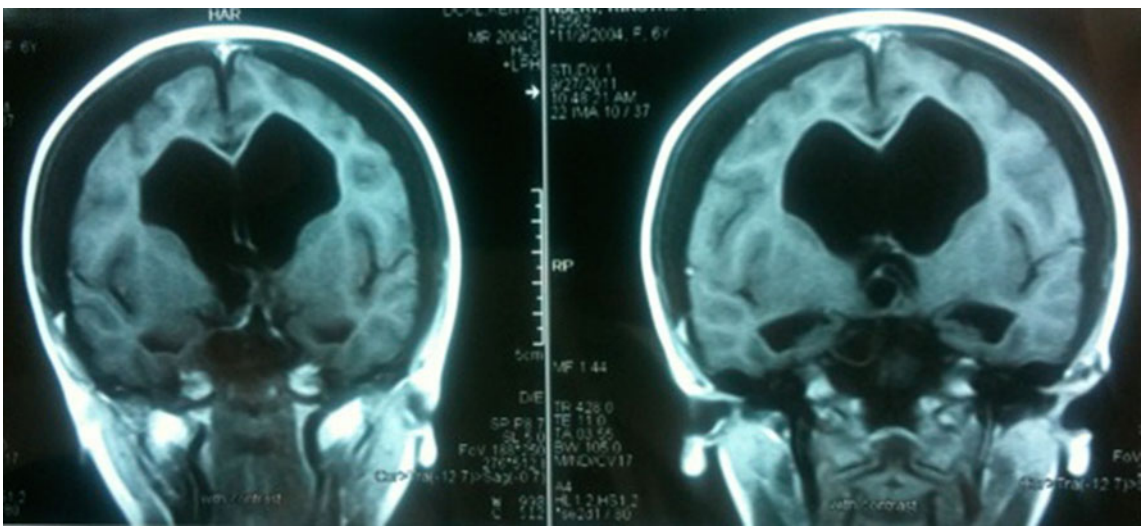

Fig. 4 Post-operative coronal CT scan demonstrating extensive removal of craniopharyngioma cysts, decreased ventriculomegaly, and the interval accumulation of extra-axial fluid

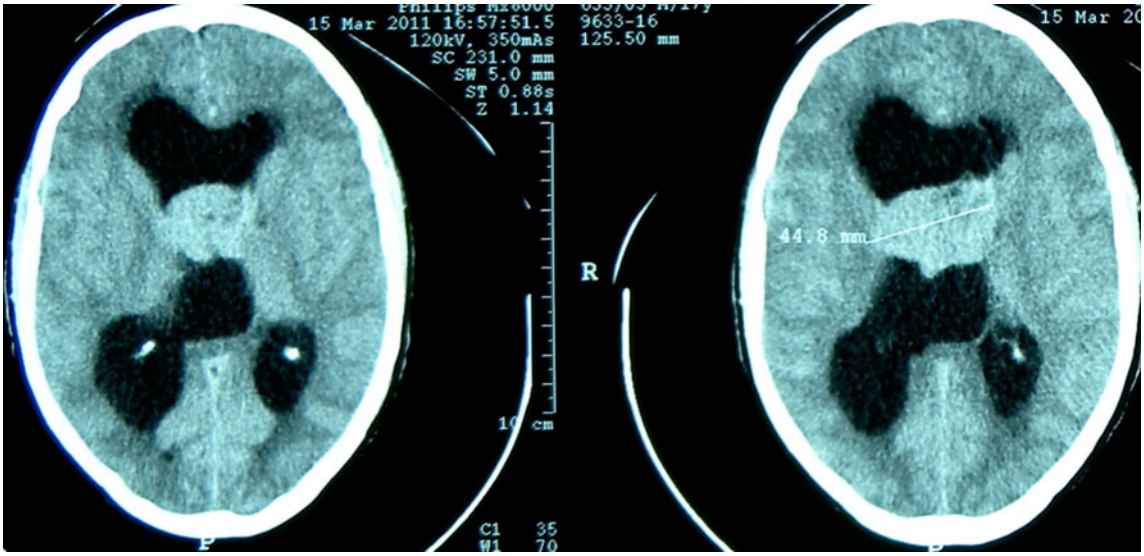

Fig. 5 Pre-operative axial CT scan demonstrating an intraventricular tumor and associated hydrocephalus

We found that Myriad handpieces could be re-sterilized and used two to four times each before the reciprocating blade became non-functional. Sterilization in 2% Steranios solution did not appear to negatively affect function of the handpieces. There was no appreciable difference in the number of times the handpieces of various sizes could be sterilized and continue to work. Sterilization by ethylene oxide would have been preferable but was not available in our hospital.

The Myriad was most helpful when working in narrow, deep spaces, such as when removing pineal region and spinal cord tumors, and was most effective in our experiences in removing softer brain tumors and tumor cyst walls, but was less helpful in removing four dense meningiomas.

Partial collapse of the ventricular system occurred when the Myriad was used for endoscopic resection of intraventricular tumors. However, this can be minimized by performing the procedure with a continuous irrigation system in place, which also improves visibility.

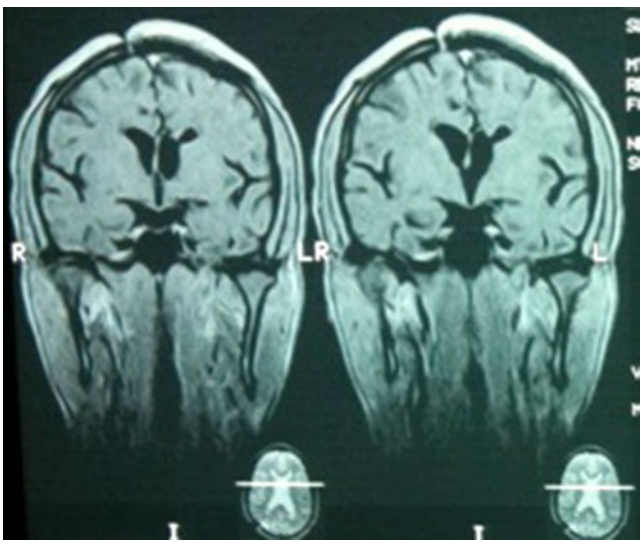

Fig. 6 Post-operative coronal MR scan demonstrating complete removal of the intraventricular tumor and resolution of the hydrocephalus

Discussion

The Myriad device is an effective method of removing many pediatric and adult brain and spinal cord tumors. It is useful in the removal of deep tumors located in small spaces where the use of larger devices, such as ultrasonic surgical aspirators, can be limited. But the Myriad's optimal usefulness is in minimally invasive approaches and endoscopic tumor removals. Dlouhy et al. [1] have reported the utility of the Myriad in the endoscopic removal of brain tumors, primarily pituitary adenomas, colloid cysts and craniopharyngiomas, in 14 adult patients. Garcia-Navarro et al. [2] used the Myriad in the endoscopic, endonasal, resections of 13 skull base tumors, primarily macroadenomas. The Myriad is the first and only device that will fit down the working channel of an endoscope, and thus greatly expands the spectrum of procedures that can be performed endoscopically.

In developing countries, the management of craniopharyngiomas is difficult: complete tumor resections via open craniotomies are associated with pan-hypopituitarism and the cost of replacement hormone therapy is prohibitive. For children who present with craniopharyngiomas that have substantial dorsal cystic components, aspiration and resection of those cysts with the Myriad seems to relieve

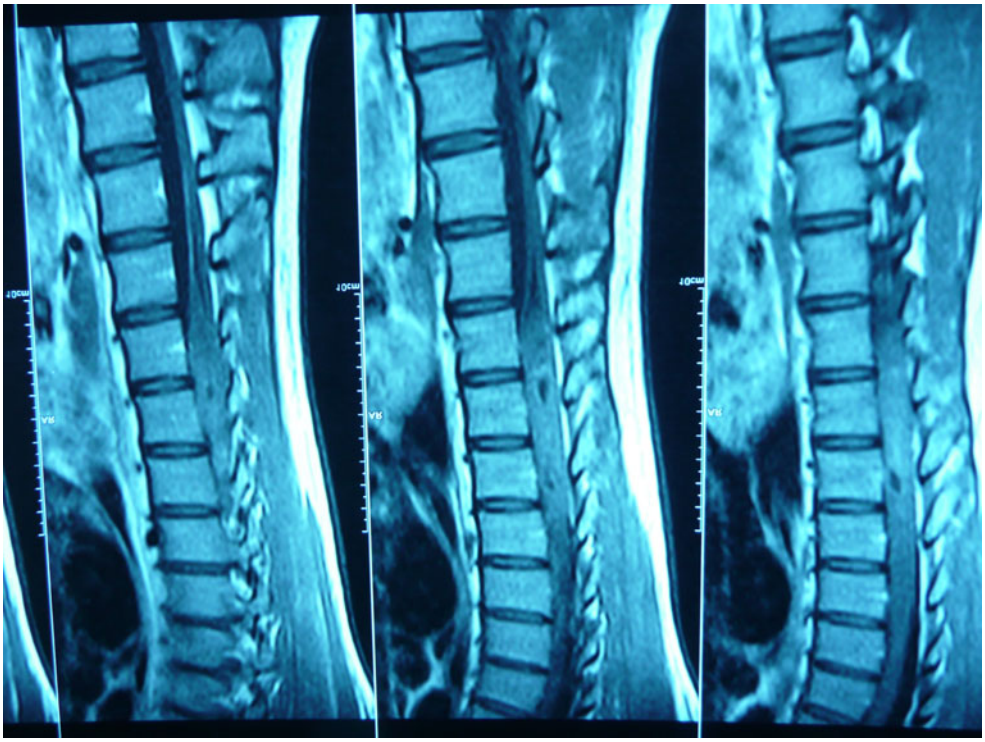

Fig. 7 Pre-operative MR scans demonstrating a thoracic intramedullary spinal cord tumor

mass effect and associated hydrocephalus and provides a temporizing measure for months to years until the child is old enough to undergo irradiation of the remaining solid component.

The Myriad console, stand and foot pedal cost approximately US$94,000 and the handpieces cost approximately US$2,900 each. A few neurosurgical centers in developing countries can afford the Myriad system, but almost none can

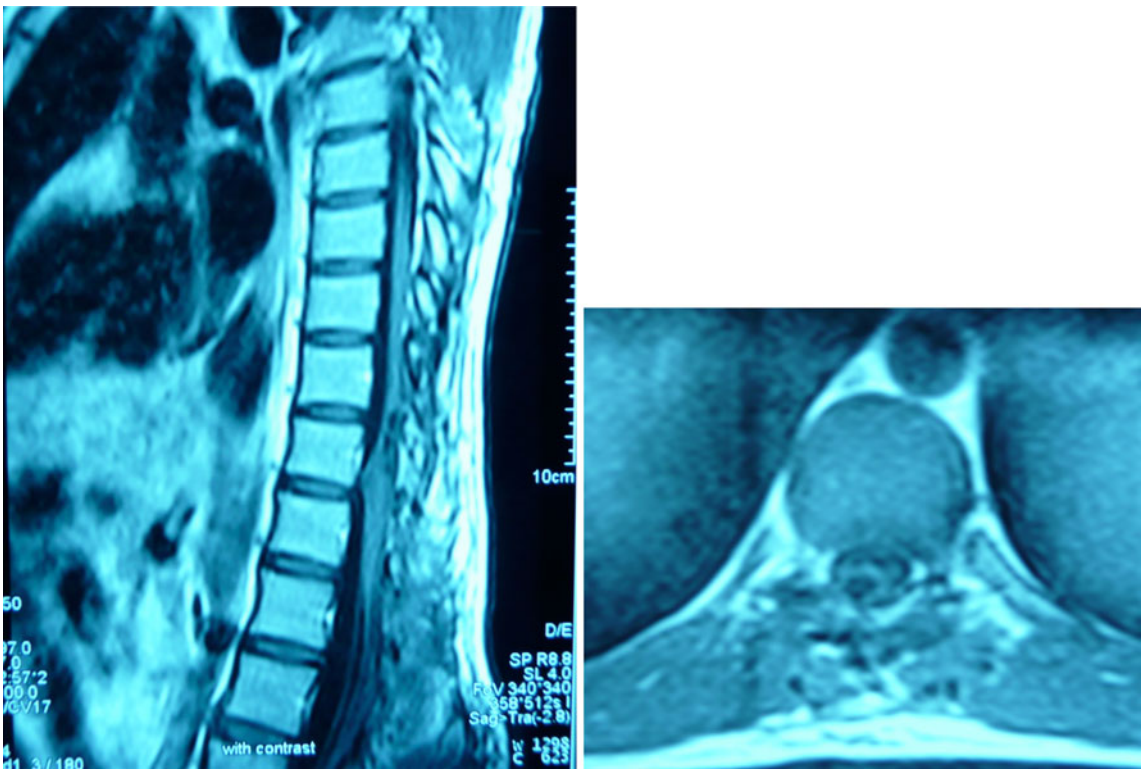

Fig. 8 Post-operative MR scans following tumor resection

afford the cost of the disposable handpieces. Although the handpieces can be re-sterilized and reused two to four times each in our experience, the cost of multiple handpieces will restrict the use of the Myriad in developing countries until a multi-use handpiece is developed.

Acknowledgement We gratefully acknowledge the generous contribution of the NICO Myriad system by the Medtronic Foundation and several handpieces donated by NICO Corporation,

Conflict of interest Dr. Albright was a grant recipient from the Medtronic Foundation, which purchased the NICO Myriad device. Dr. Okechi was the recipient from the Medtronic Foundation of support of a pediatric neurosurgery fellowship at Kijabe Hospital.

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