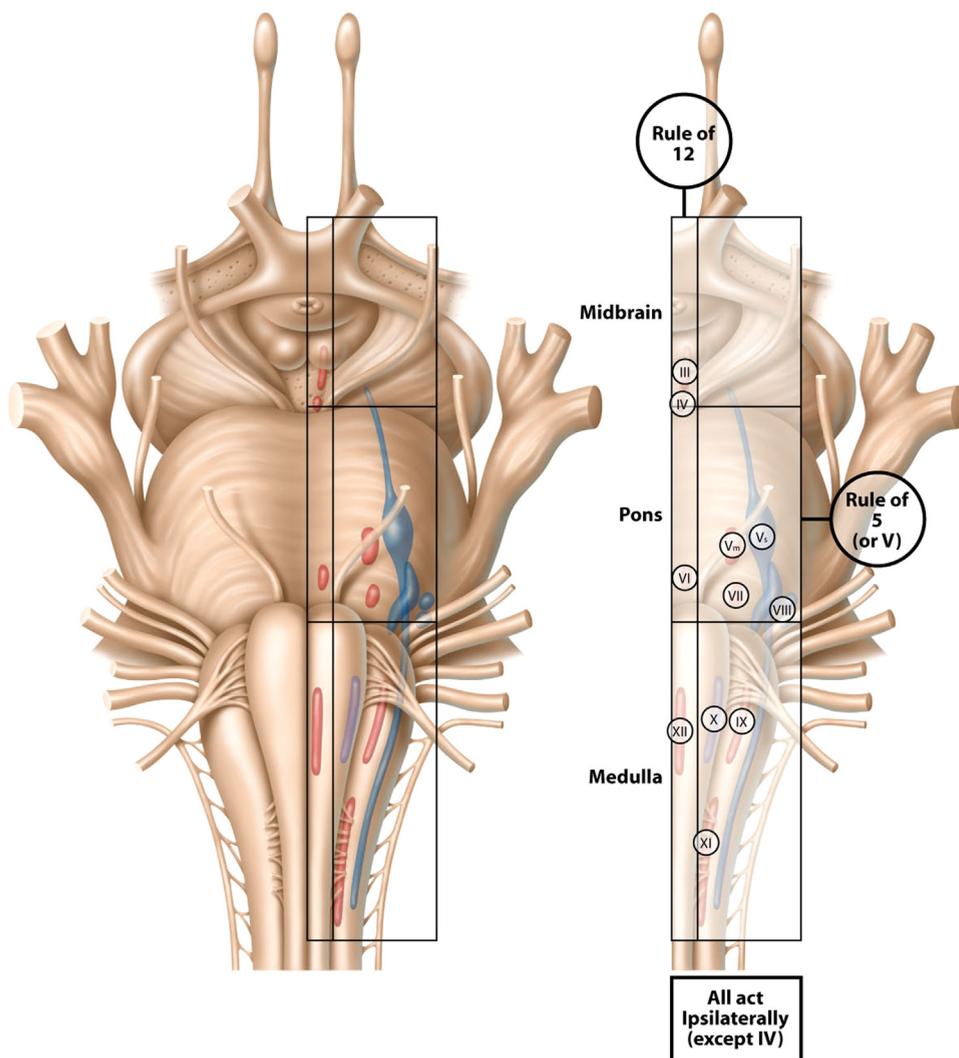


# Learning Brainstem Anatomy: A Mnemonic Device

James T. McDeavitt, MD, Kara C. King, PhD, Kathleen R. McDeavitt, BA

## INTRODUCTION

Memorization and integration of relevant factual knowledge remains a challenge for physicians in training, as well as for those in practice. For example, it has been well documented that retention of basic science knowledge deteriorates during undergraduate training [1]. Mnemonic devices are well-established teaching tools, and have been suggested as a means to increase retention. It has been demonstrated that middle-school



**Figure 1.** Rules of 5 and 12. These rules divide the brainstem visually into 6 sections. Application of the rules establishes the location of each of the cranial nerve nuclei in the appropriate level of the brainstem (Rule of 5), and establishes whether it is medial or lateral (Rule of 12).

**J.T.M.** Physical Medicine and Rehabilitation, Baylor College of Medicine, One Baylor Plaza, BCM-635, Houston, TX 77030. Address correspondence to: J.T.M.; e-mail: [james.mcdeavitt@bcm.edu](mailto:james.mcdeavitt@bcm.edu)

Disclosure: nothing to disclose

**K.C.K.** Carolinas HealthCare System, Charlotte, NC

Disclosure: nothing to disclose

**K.R.M.** University of North Carolina School of Medicine, Chapel Hill, NC

Disclosure: nothing to disclose

The authors thank Anne Olson, medical artist, for preparation of the figures, and Lisa Howley, PhD, and Sanjay Iyer, MD, for review of the manuscript.

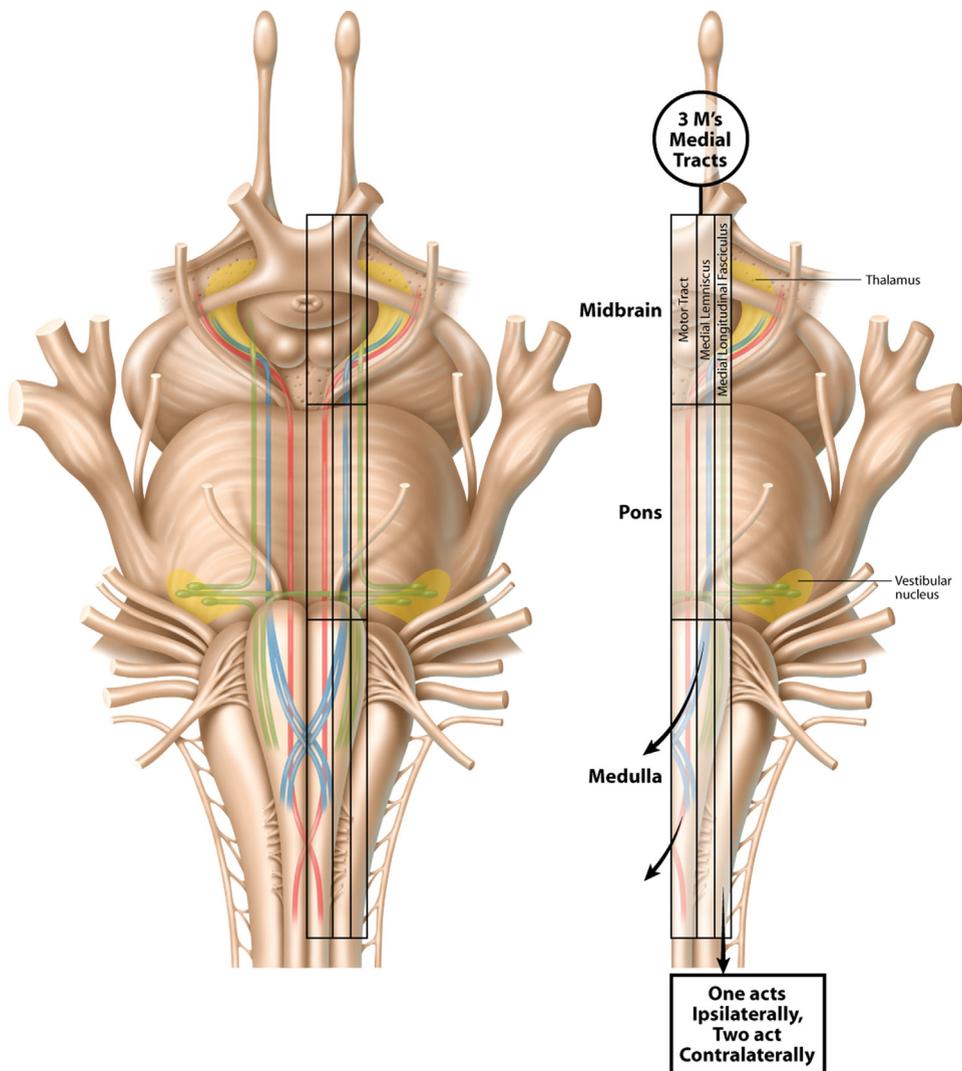
Submitted for publication March 2, 2014; accepted March 29, 2014.

students who learn new vocabulary words with mnemonic aids display enhanced retention [2]. To recall the cranial nerves, most medical students could complete the 12-word phrase starting with “On Old Olympus’ Towering Top...”, or some other version. The efficacy of mnemonic devices has been studied in resident physicians to improve a wide variety of retention tasks, from improving skills in the diagnosis of otitis media [3] to the efficient structuring of clinical encounters [4,5]. A recent study demonstrated that pharmacy residents who were taught using a mnemonic recognized more drug-related problems in their intensive care unit patients than residents who were not taught mnemonically [6]. In this brief report, a 3-part simple mnemonic device is presented to aid in the retention of brainstem neuroanatomy—the Rule of 5, the Rule of 12, and the Rule of

M/S—which can assist physicians in establishing the location of brainstem cranial nerve (CN) nuclei and long tracts. The 3 rules, when combined and used in conjunction with the physical examination, can be useful in localizing brainstem pathology, and may constitute a useful teaching tool for medical educators.

### Rule of 5

The first rule, the “Rule of 5” (or the Roman numeral “V”), establishes each of the cranial nerve nuclei in the appropriate level of the brainstem (The “Rule of 5” has previously been published, in an article read by one of the authors in or about 1985. Publication date is believed to be 1958. Extensive efforts to locate the original article failed). Every



**Figure 2.** Rule of M/S: Medial Tracts. Application of the Rule of M/S identifies 3 medial tracts, all beginning with the letter “M”: Motor tract (ie, corticospinal tract), Medial lemniscus, and Medial longitudinal fasciculus.

cranial nerve nucleus that contains the Roman numeral V is located in the pons. Cranial nerve III is cephalad, in the midbrain. Cranial nerves IX through XII are caudad and are located in the medulla. All of the nerves exit the brainstem and provide predominantly ipsilateral innervation to structures of the head and face, with the exception of CN IV, which crosses and acts contralaterally.

There are 2 minor exceptions to this rule. Cranial nerve IV is actually in the junction between the midbrain and pons. Cranial nerve V has 2 distinct components. The motor portion of the nucleus clearly resides in the pons, and follows the rule. The sensory nucleus is highly elongated and extends well into the medulla (Figure 1).

### Rule of 12

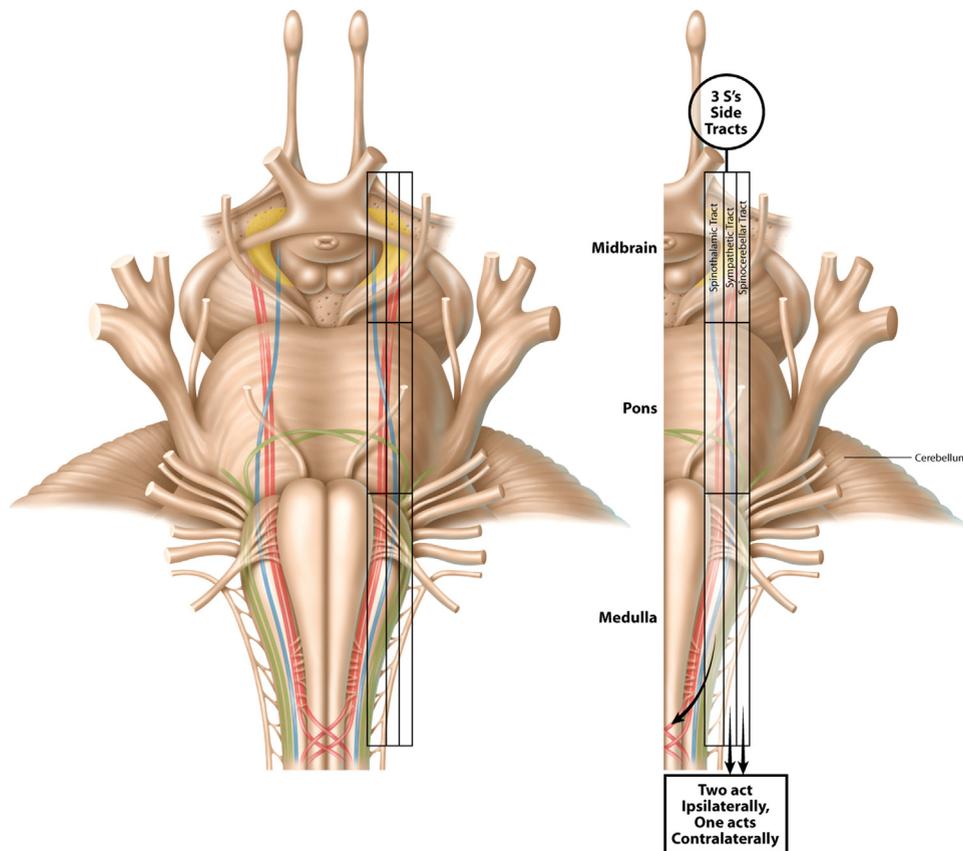
Both the “Rule of 12” and rule that follows (“Rule of M/S”) are modifications of previously described methods [7]. The “Rule of 12” establishes the position of a nucleus medially or laterally, and is very simple to administer. Any nucleus that is a factor of 12, inclusive of 12, is medial (III, IV, VI, XII). The remainder are lateral (Figure 1).

### Rule of M/S

The “Rule of M/S” helps to establish where the long tracts of the brainstem run: medially or laterally. This mnemonic requires some simple nomenclature gymnastics. The “M” in the rule stands for “medial”; the “S” stands for “side”, or lateral brainstem. There are 3 primary medial tracts in the brainstem: the motor tract (more accurately, the cortico-spinal tract), the medial lemniscus, and the medial longitudinal fasciculus. All of these medial tracts start with the letter “M” (Figure 2).

There are also 3 lateral or “side” tracts: the spinothalamic tract, the sympathetic tract, and the spinocerebellar tract. All of the “side” tracts start with the letter “S” (Figure 3).

One remaining area of complexity is that half of the tracts listed above act ipsilaterally, whereas the other half decussate and act contralaterally. Here the mnemonic device becomes a little strained. In general, those tracts that control functions that one might assess in a cursory neurologic examination tend to act contralaterally; those tracts that control functions typically reserved for a more detailed neurologic examination tend to act ipsilaterally. Thus, motor function (motor



**Figure 3.** Rule of M/S: Lateral Tracts. Application of the Rule of M/S identifies 3 lateral (or side) tracts: Spinothalamic, Sympathetic, and Spinocerebellar.

tract/corticospinal tract), pain sensation (spinothalamic tract), and vibratory/position sense (medial lemniscus) are all crossed functions. Sympathetic function (sympathetic tract), ataxia (spinocerebellar tract), and coordination of bilateral gaze (medial longitudinal fasciculus) all act (predominantly) ipsilaterally.

## SUMMARY

Basic brainstem neuroanatomy can be recalled through the application of 3 simple rules:

- Rule of 5: Localizes a nucleus to the midbrain, pons, or medulla
- Rule of 12: Localizes a nucleus to the medial or lateral brainstem
- Rule of M/S: Establishes if a long tract in the brainstem courses laterally or medially

## REFERENCES

1. Ling Y, Swanson DB, Holtzman K, Bucak SD. Retention of basic science information by senior medical students. *Acad Med* 2008;83:S82-S85.
2. Levin JR, Levin ME, Glasman LD, Nordwall MB. Mnemonic vocabulary instruction: Additional effectiveness evidence. *Contemp Educ Psychol* 1992;17:156-174.
3. Kaleida PH, Ploof DL, Kurs-Lasky M, et al. Mastering diagnostic skills: Enhancing Proficiency in Otitis Media, a model for diagnostic skills training. *Pediatrics* 2009;124:e714-e720.
4. Wolpaw TM, Wolpaw DR, Papp KK. SNAPPS: A learner-centered model for outpatient education. *Acad Med* 2003;78:893-898.
5. Knops K, Lamba S. Clinical application of ASCEND: A pathway to higher ground for communication. *J Palliat Med* 2010;13:825-830.
6. Masson SC, Mabasa VH, Malyuk DL, Perrott JL. Validity evidence for FASTHUG-MAIDENS, a mnemonic for identifying drug-related problems in the intensive care unit. *Can J Hosp Pharmacol* 2013;66:157-162.
7. Gates P. The Rule of 4 of the brainstem: A simplified method for understanding brainstem anatomy and brainstem vascular syndromes for the non-neurologist. *Intern Med J* 2005;35:263-266.