INSTITUT CHIARI & SIRINGOMIELIA & ESCOLIOSIS DE BARCELONA

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Plan of presentation

- **1.1. Anatomy of *Filum terminale***
- **1.2. Histology of *Filum terminale***
- **1.3. Physiology of *Filum terminale***
- **1.4. Embryology of *Filum terminale***

- **2.1. Definition of Filum disease**
- **2.2. Definition of Neuro-cranio-vertebral syndrome**
- **2.3. Basic statistics**
- **2.4. Clinical picture**
- **2.5. Image features**

- **3.1. The Filum System**
- **3.2. Sectioning of Filum terminale**
- **3.3. Other interventions**

- **4. Results of Filum System**

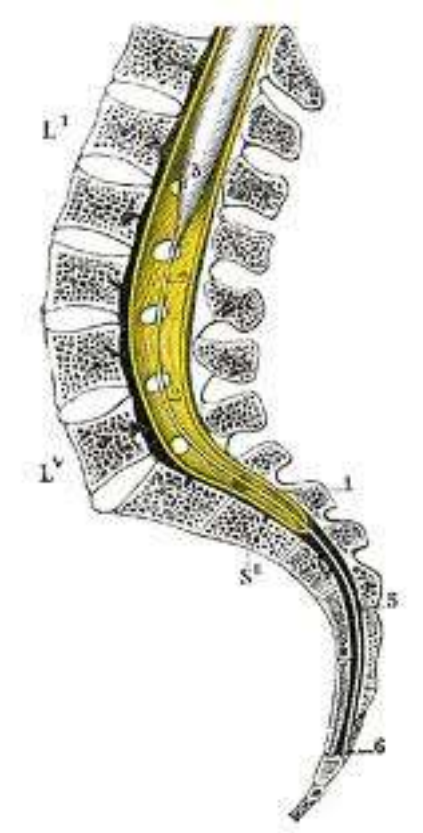
- **5. Conclusions**.

1.1. Anatomy of *Filum terminale*

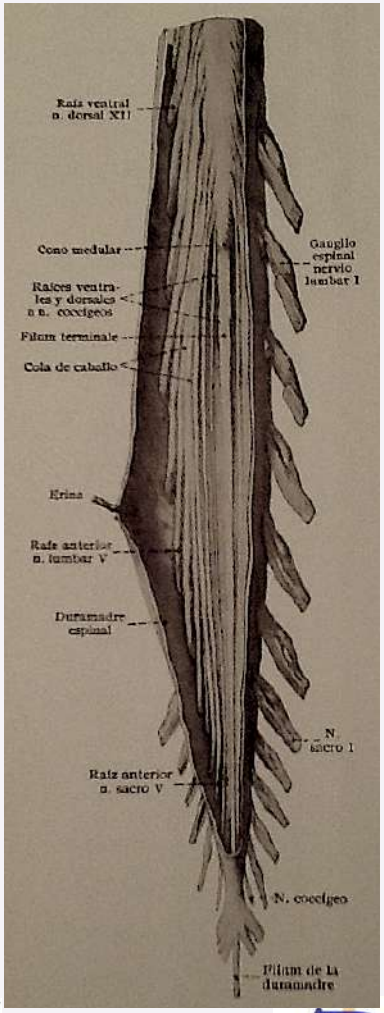
- Fibroelastic ligament between the *Conus medullaris* and the dorsal surface of the tailbone.
- About 23 cm in length.
- Thickness of 1-2 mm.
- Accompanied by a visible arterial blood vessel over its entire length.
- Comprises a longer initial intradural segment (*Filum terminale internum*) and a shorter distal extradural segment (*Filum terminale externum*), the latter covered by a prolongation of the *dura mater*.

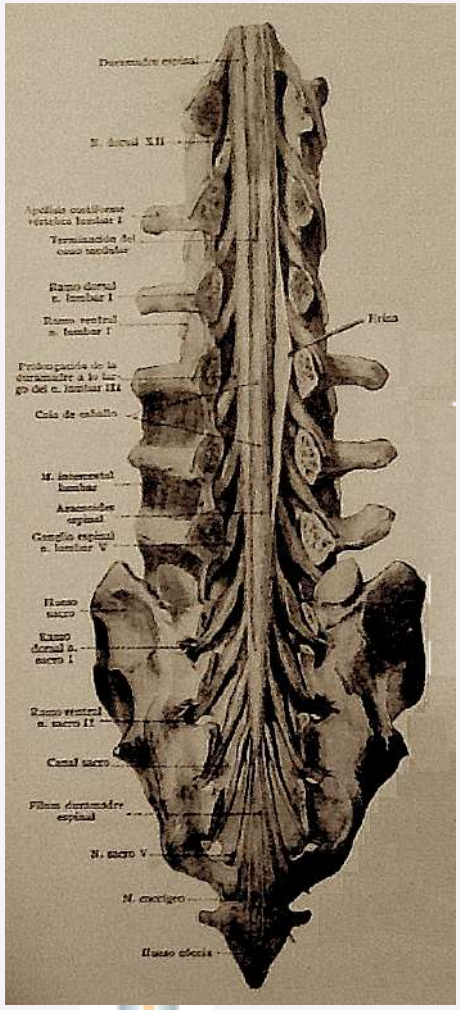
The *Filum terminale*

Conus medullaris and *Filum terminale* in anatomy textbooks:



L. Testut y A.Latarjet 1902-1928





Werner Spalteholz 1895

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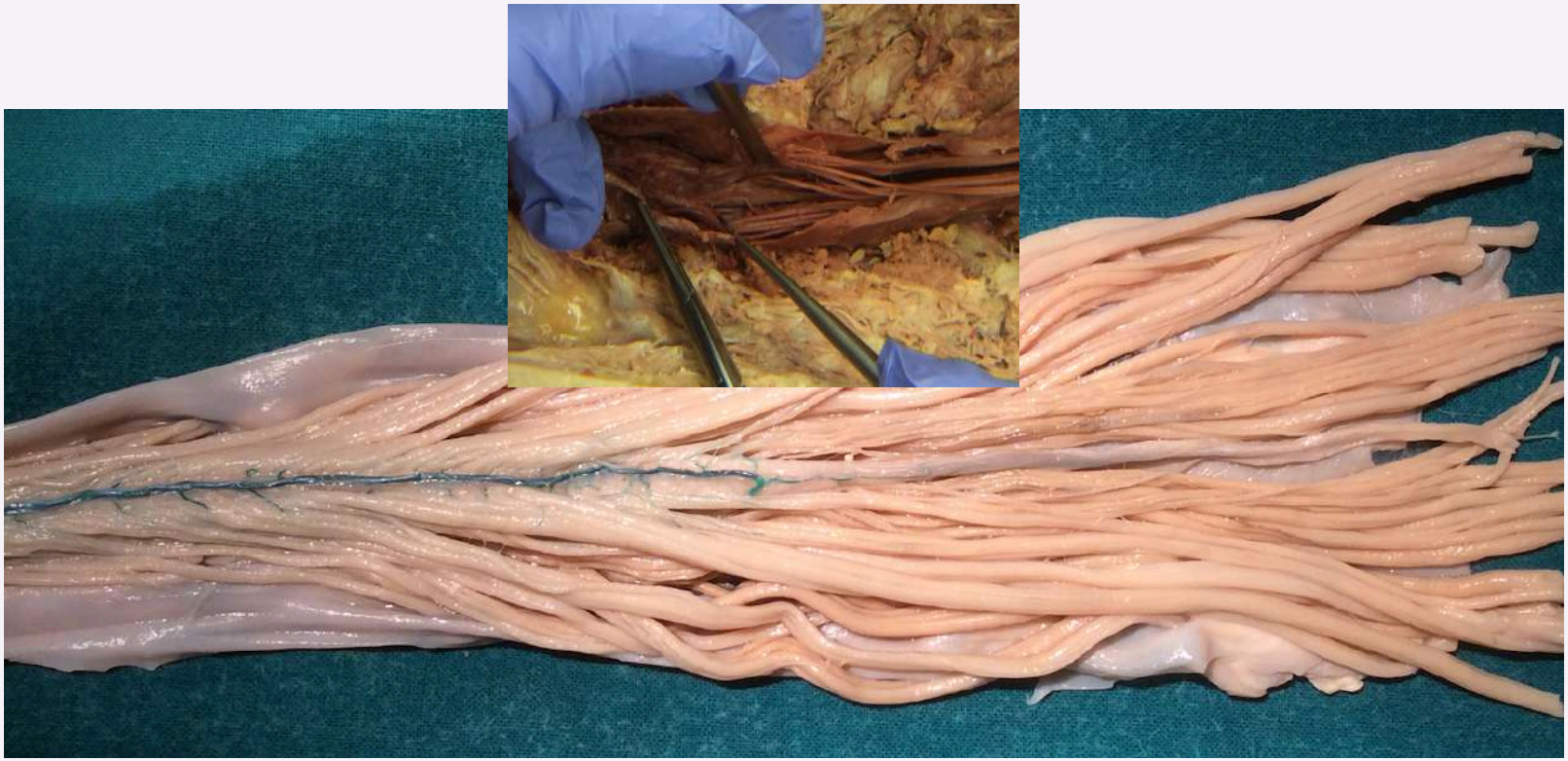
FILUM SYSTEM

The *Filum terminale*

Filum terminale in cadaver dissections:



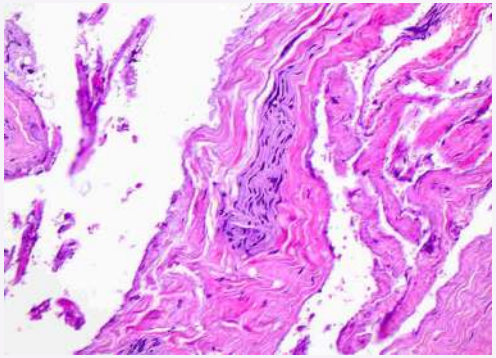
The *Filum terminale*

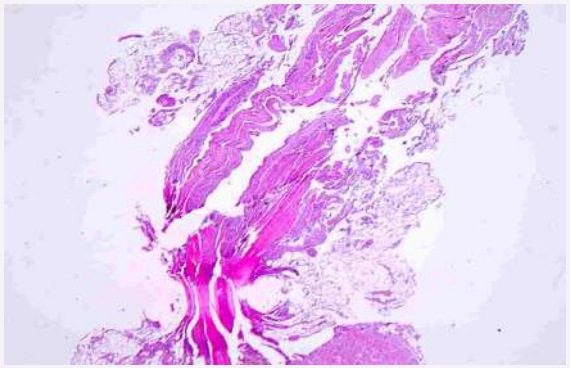
***Filum terminale* in individual with scoliosis** (prepared by Professor Alfonso Rodriguez Baeza, Chair of Human Anatomy and Embriology, Faculty of Medicine, Universidad Autónoma de Barcelona, 2017).

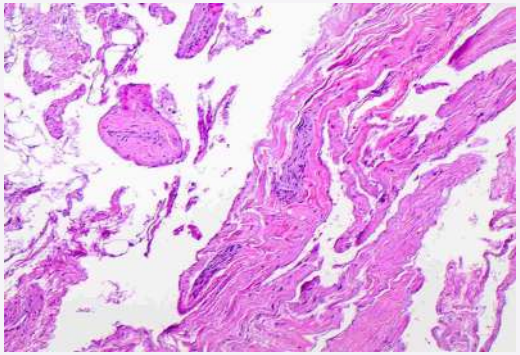
1.2. Histology of *Filum terminale*

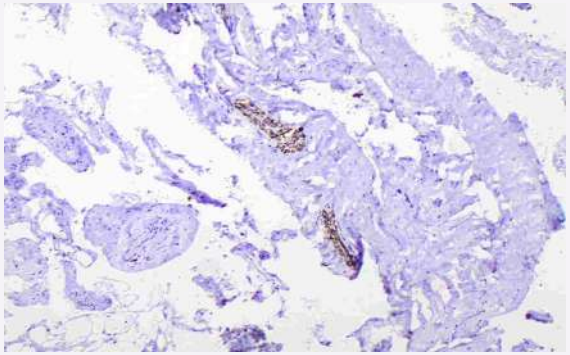
- Collagen fibers
- Elastin fibers
- Atrophic neurons
- Atrophic neural fibers
- Fibrous and adipous tissue with multiple small blood vessels
- Scarce neural filaments positive for S100 Protein
- Various types of glial cells.

The *Filum terminale*



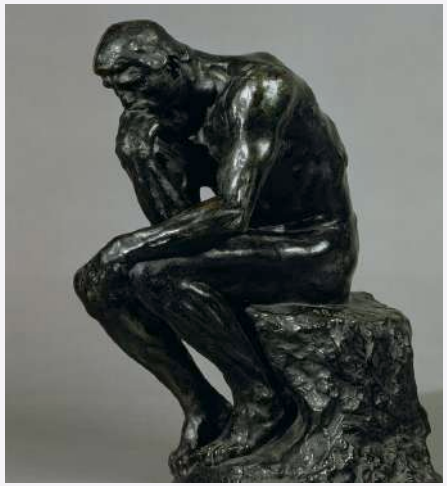






1.3. Physiology of *Filum terminale*

- Maintains the alignment of the spinal cord within the spinal canal.

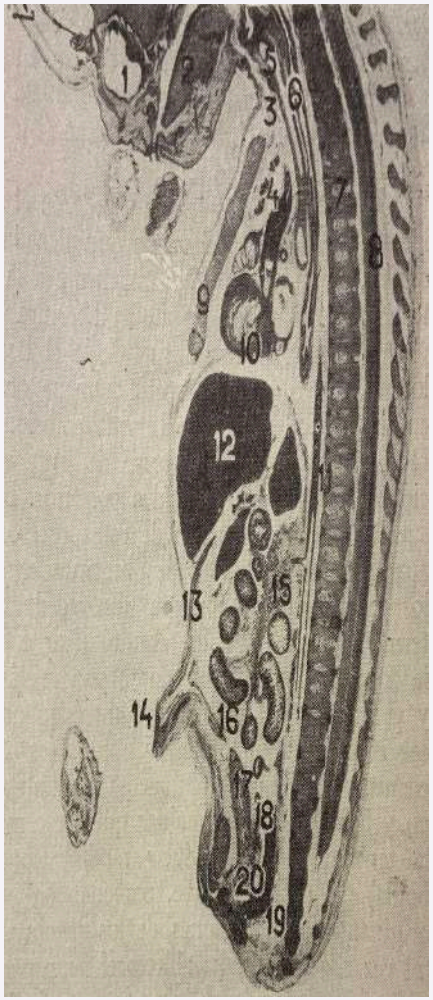


1.4. Embryology of *Filum terminale*

- Initiated by involution of the distalmost spinal cord through *retrogressive differentiation*;
- It becomes visible in the 9th gestational week, as a consequence of the differential growth of the spine and spinal cord;
- It contains both ectodermal and mesodermal-origin components.

The *Filum terminale*

9-week-old human embryo, at the beginning of the differential growth of the spine and spinal cord



Conus medullaris level in humans:

- **Starts to ascend during the 9th week;**
- At 3 months: **2nd coccygeal vertebra**;
- At 5 months: **1st sacral vertebra;**
- At 6 months: **L_3-L_4.**
- At birth: **inferior part of L_3;**
- During adulthood: **between $D_{12}L_1$ and L_1L_2.**

Normal *Conus medullaris* level in adults:

- **Th_{12}-L_1 (Roth 1981, Royo-Salvador 1996)**
- L_1 (Arai el al. 2001, Pou Serradell 1981)
- L_1-L_2 (Williams et al. 1995)
- Above upper L_2 (Nieuwenhuys et al. 2009)
- Above L_2 (Heimberger 1950)
- Above inferior third of L_2 (McCotter, 1916)
- Between Th_{11} and L_3 (Neel, 2016)

Conus medullaris **level**

In MRI of 55 control subjects (Royo Salvador, 1993)

- Th_{11}-Th_{12}: 1 (2%)
- **$Th_{12}L_1$ disc: 25 (50 %)**
- L_1 vertebral body: 21 (42 %)
- Inferior margin of L_1: 1 (2%)
- L_1L_2 disc: 2 (4%)

2.1. Definition of Neuro-Cranio-Vertebral Syndrome

- **Group of subjective and objective clinical manifestations, affecting the encephalon, the spinal cord, the skull and the vertebral column, referable to an abnormal axial traction transmitted by a *Filum terminale* apparently normal;**
- **It can be associated to known conditions of unknow etiology so far, as the Arnold-Chiari type I syndrome, Idiopathic scoliosis, Idiopathic syringomyelia, Platibasia, Odontoid retroflexion, Brainstem kinking, etc.**

2.2. Definition of *Filum* disease

- **Congenital form of Neuro-Cranio-Vertebral Syndrome with an apparently normal *Filum terminale*;**
- **It can be manifested through different pathologies: Arnold-Chiari type I syndrome, idiopathic scoliosis and syringomyelia , platybasia, odontoid retroversion, brainstem kinking, etc.**

Estimated worldwide prevalence of Filum disease

- **CONVENTIONAL DIAGNOSES**: 616 millions idiopathic scoliosis + 7 millions Chiari I + 580,000 idiopathic syringomyelia

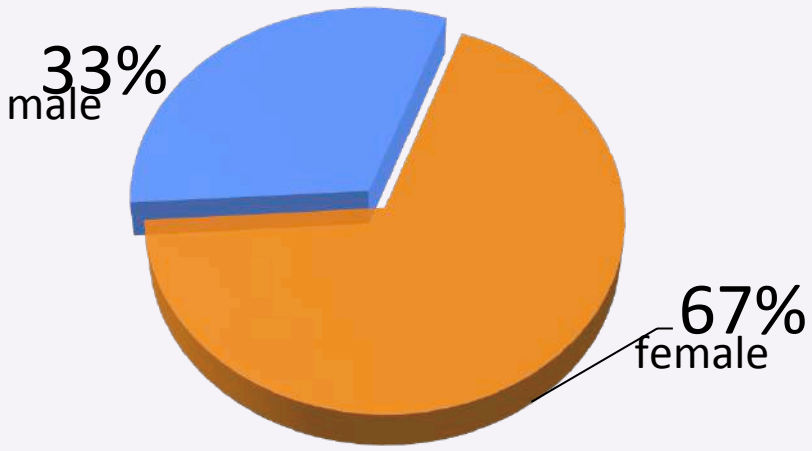
  =623,588,000 patients or 8.9 % of world population

- **ACTUAL ESTIMATE**: + scolioses < 11º + subclinical Chiari I and syringomyelia + related pathologies (occipito-cervical junction malformations)

  > 20 % of world population

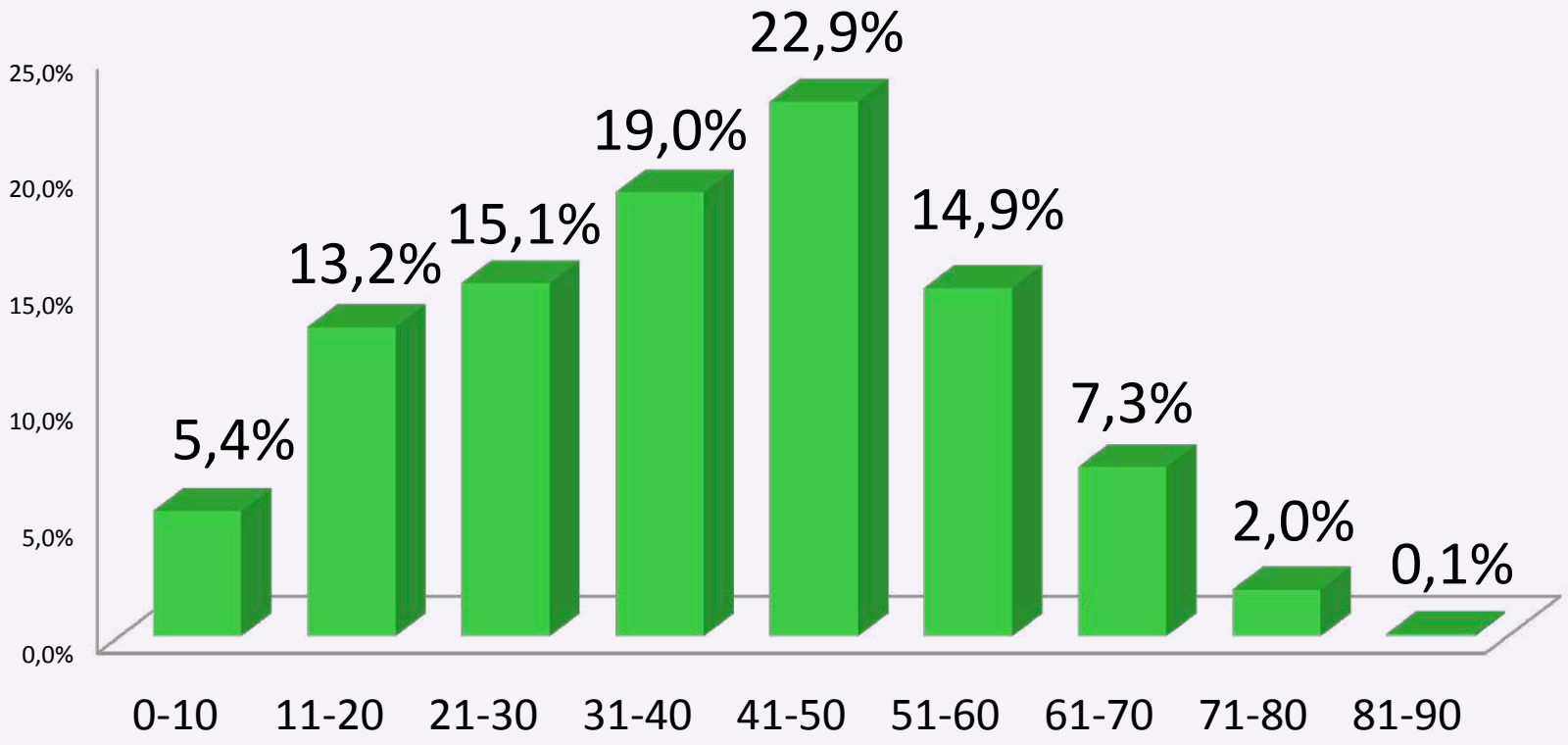
2.3. Basic statistics:

Sex distribution in 850 cases



The *Filum terminale*

Age distribution in 850 cases



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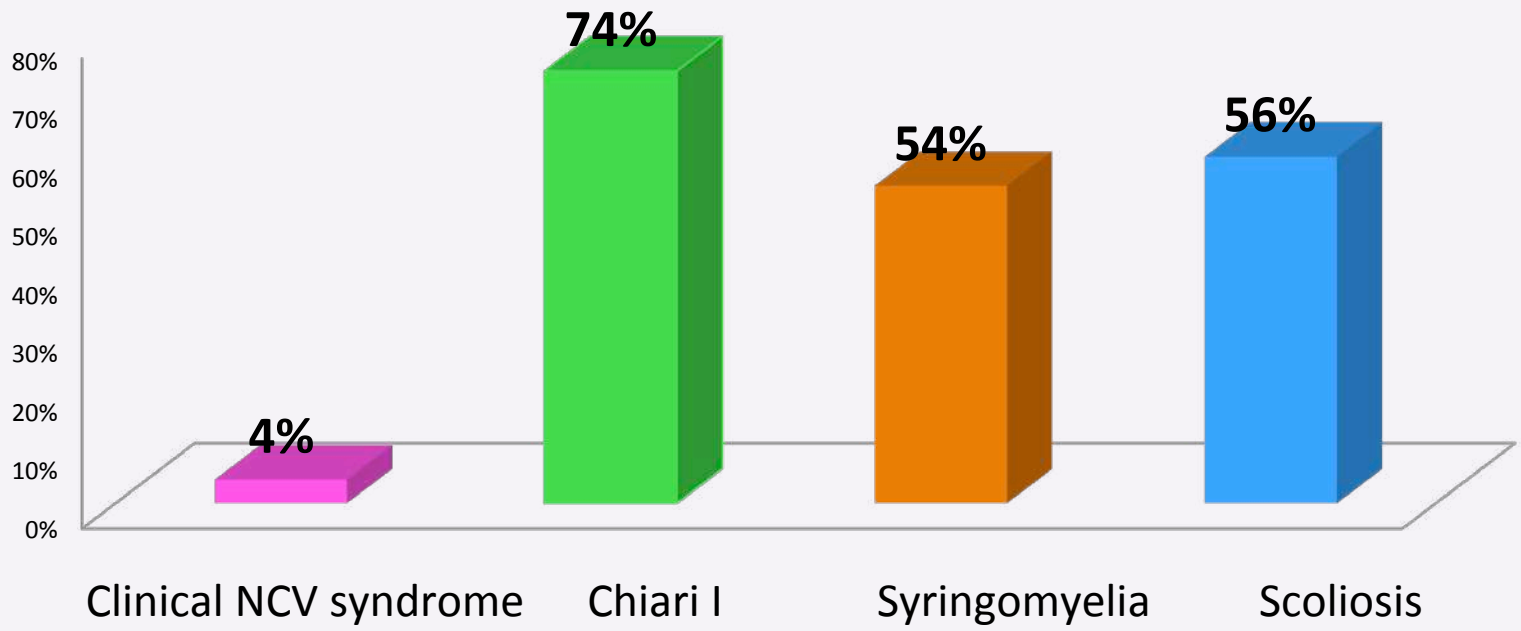
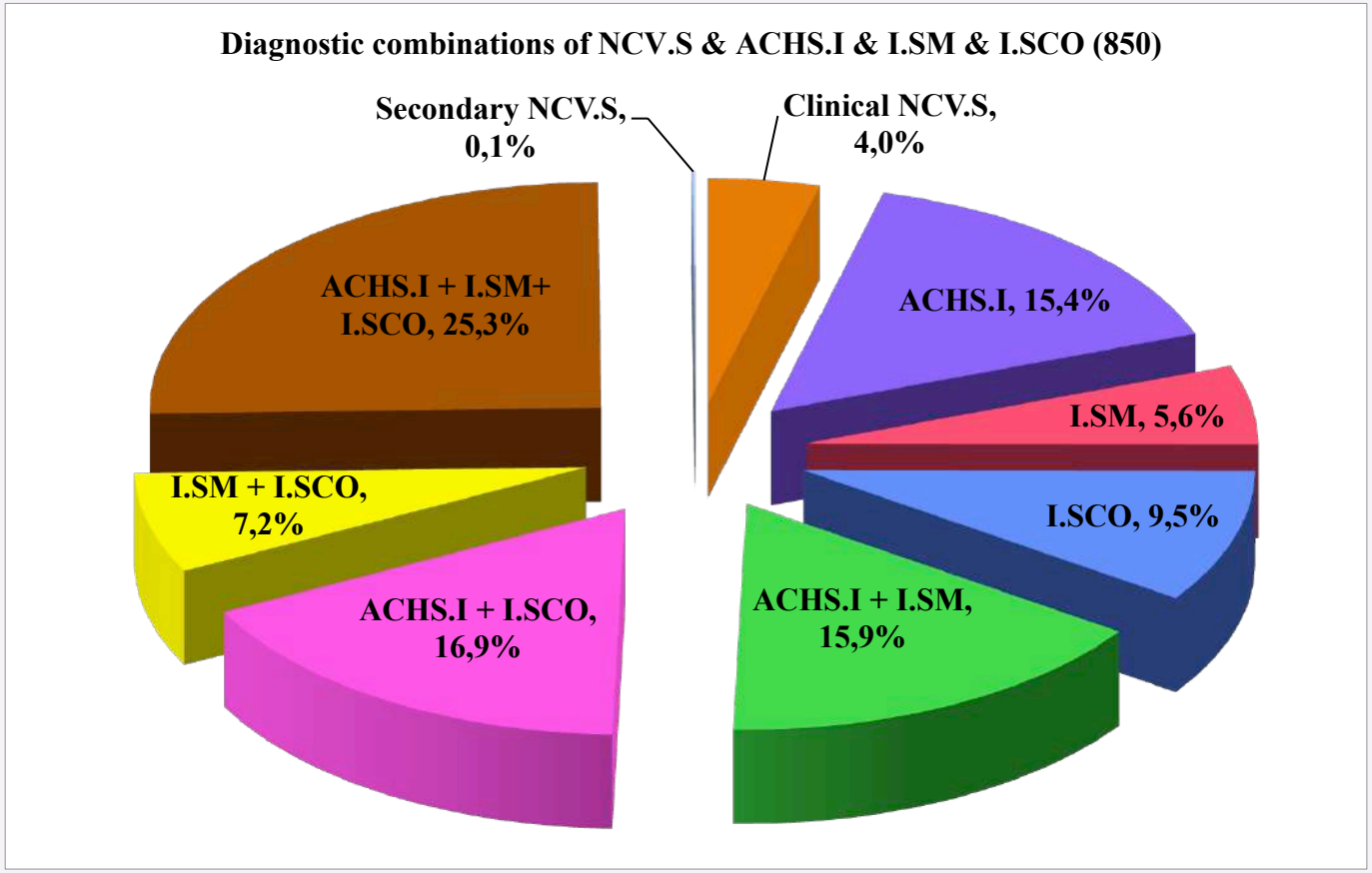
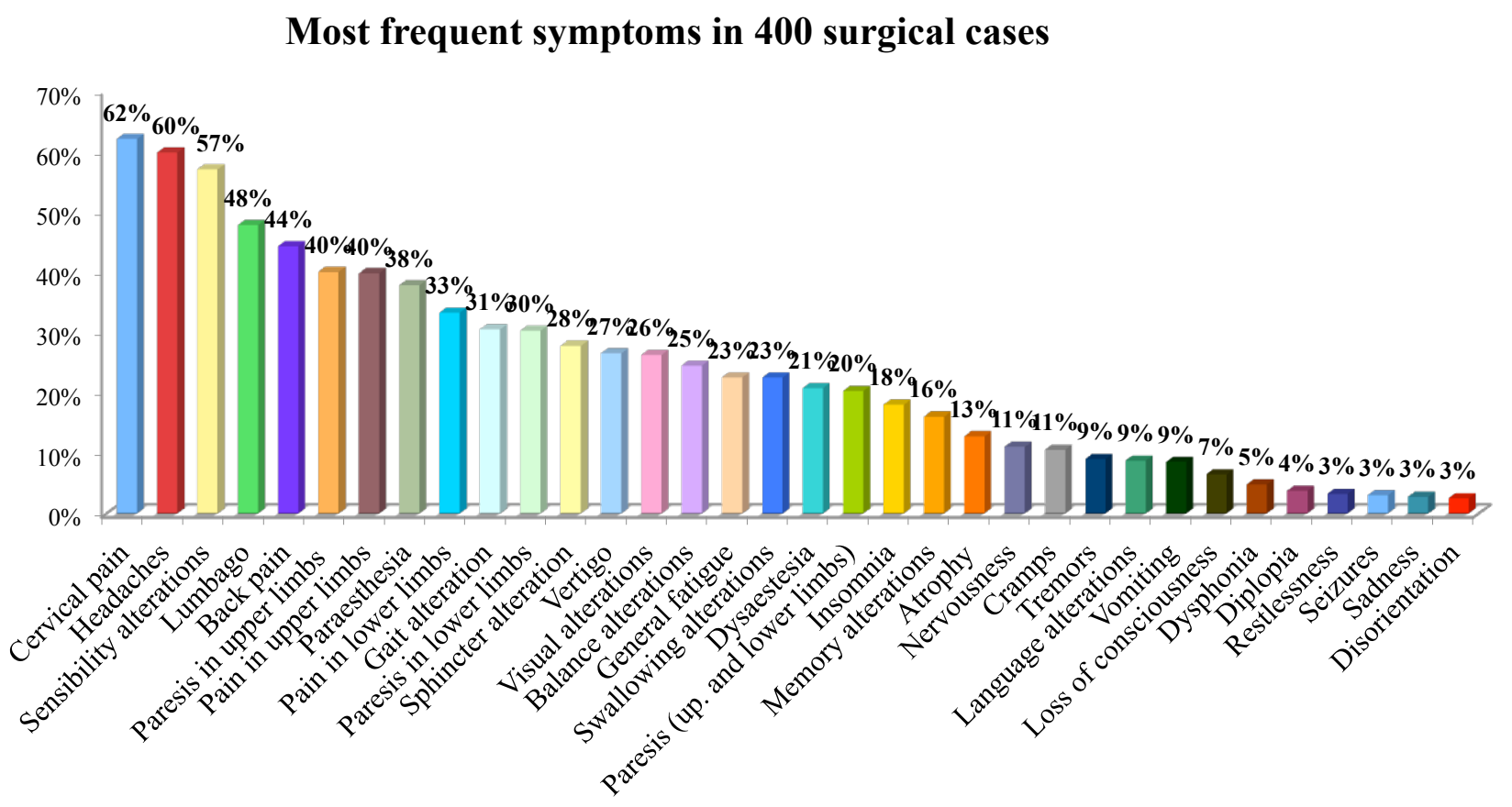
Ratio of classical diagnoses in 850 cases



Combinations of classical conditions in 850 cases



2.4. Clinical picture

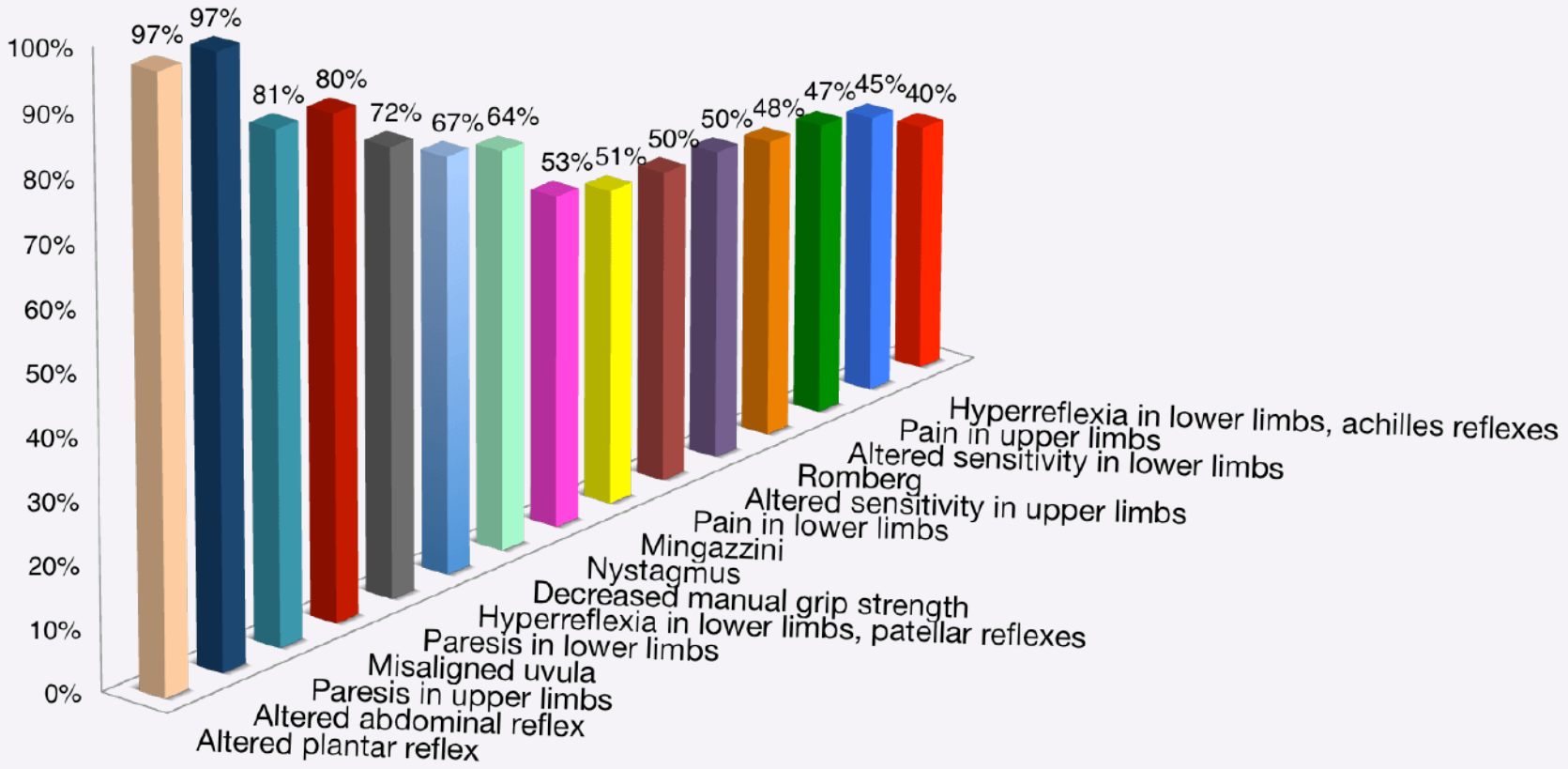


Physical findings

- 1) Spontaneous nystagmus
- 2) Deviation of uvula and/or tongue
- 3) Diminished grip strength
- 4) Alterations of temperature sensibility
- 5) Alterations of touch sensibility
- 6) Altered deep tendon reflexes in upper limb(s)
- 7) Altered deep tendon reflexes in lower limb(s)
- 8) Altered abdominal cutaneous reflexes
- 9) Altered plantar cutaneous reflexes
- 10) Positive straight-leg raising test and reversed Lasègue's test
- 11) Positive Mingazzini's and Barré's tests
- 12) Positive Romberg's test
- 13) Difficulty standing up from a kneeling posture
- 14) Scoliotic attitude and associated signs.

The *Filum terminale*

Most frequent clinical signs in 400 surgical cases



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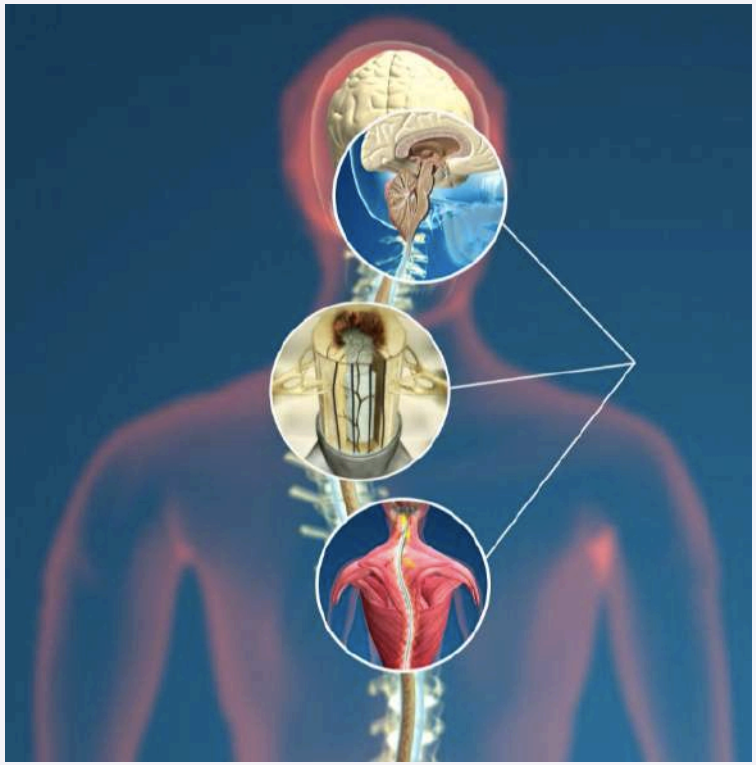
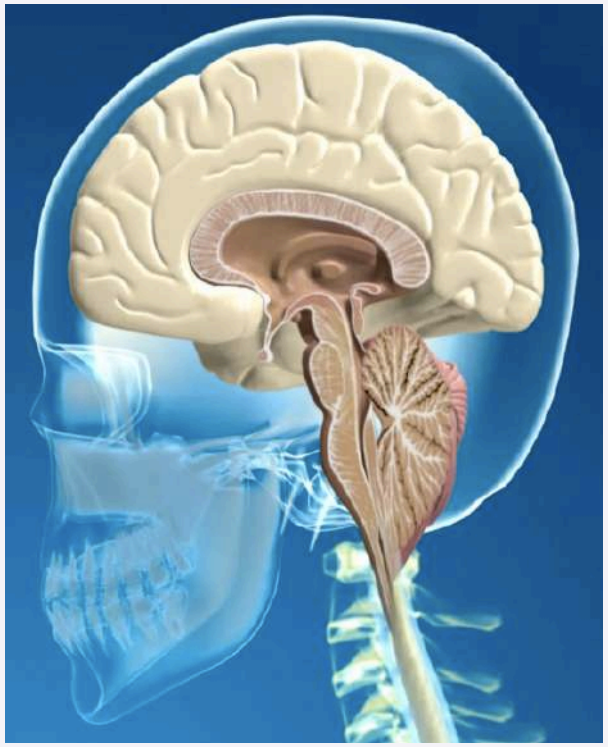
2.5. Image features of *Filum* disease:

Global view

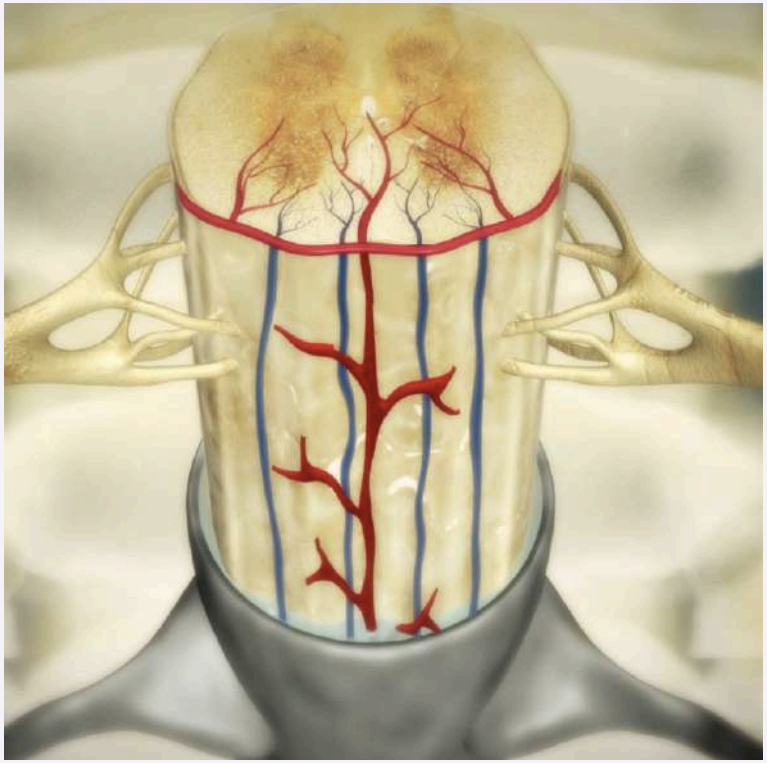


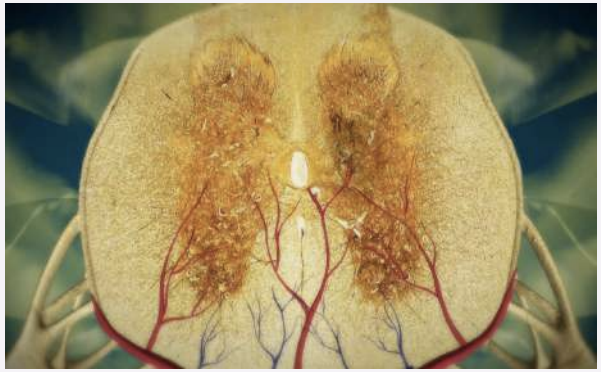
Arnold-Chiari type I syndrome – caudal traction pathogenesis

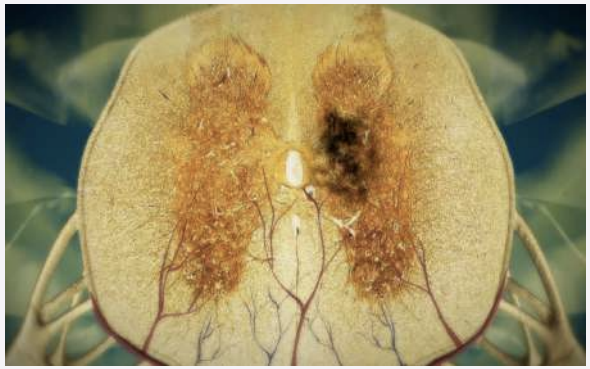


Idiopathic syringomyelia

Idiopathic syringomyelia – ischemic pathogenesis

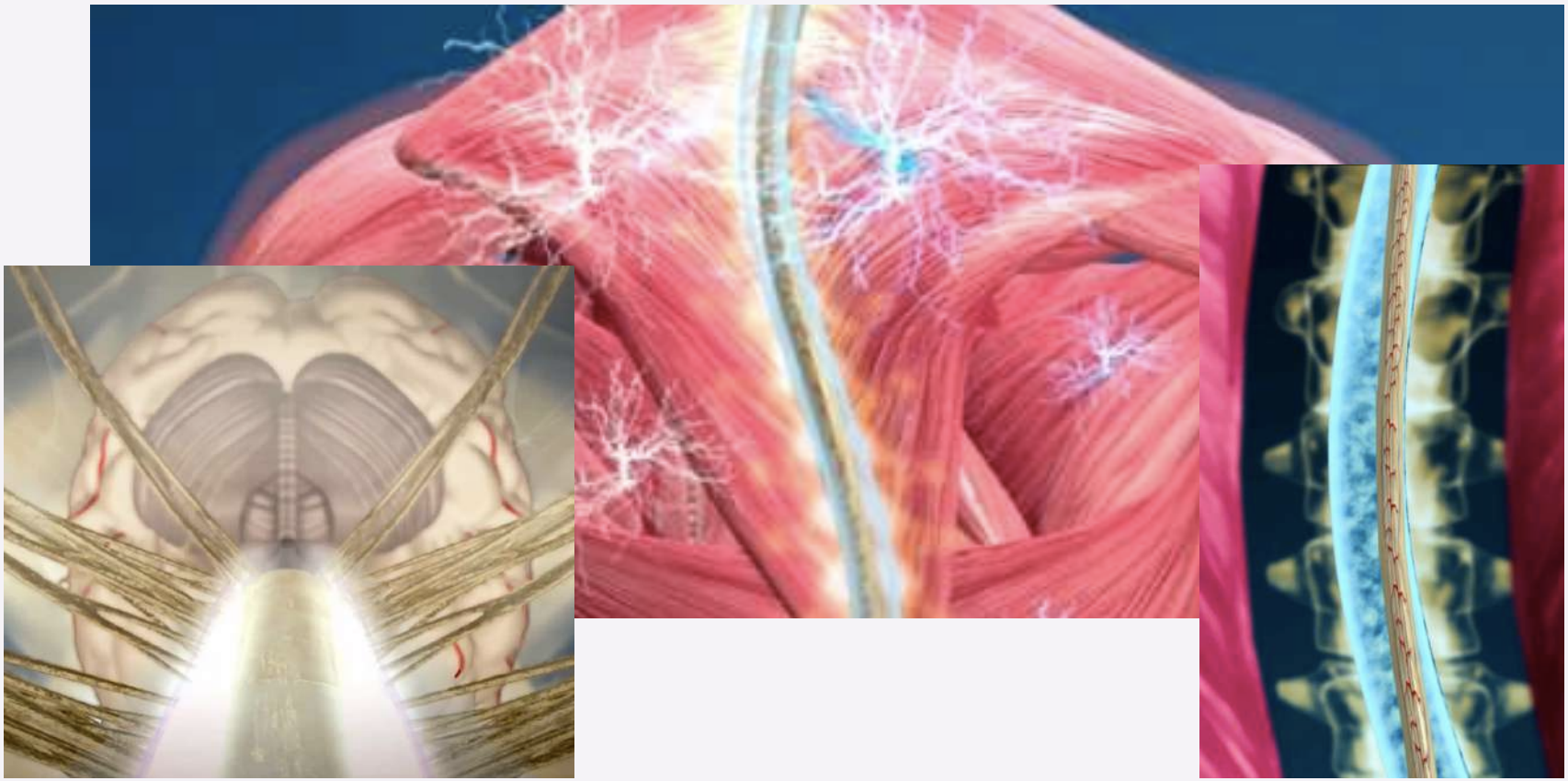






Idiopathic scoliosis

Idiopathic scoliosis – neurogenic pathogenesis

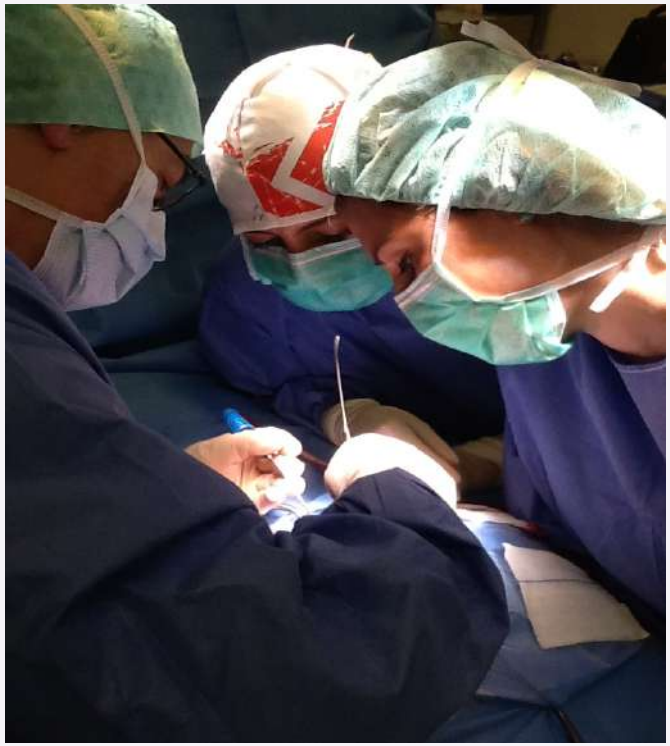


3.1. The FILUM SYSTEM®= 16 protocols

I. Diagnosis
II. Treatment
III. Preoperative and Anaesthesia
IV. **Surgical**
V. Postoperative
VI. Results
VII. Postoperative medical treatment
VIII. Postoperative physical therapy and rehabilitation
IX. Postoperative orthoses and prostheses
X. Postoperative check-up and genetics
XI. Information
XII. Future
XIII. Spinal surgery
XIV. Institute of filum
XV. Case series
XVI. Actualizations and related documents

3.2. Sectioning of *Filum terminale*

original minimally invasive technique
local anesthesia with sedation
possible day surgery

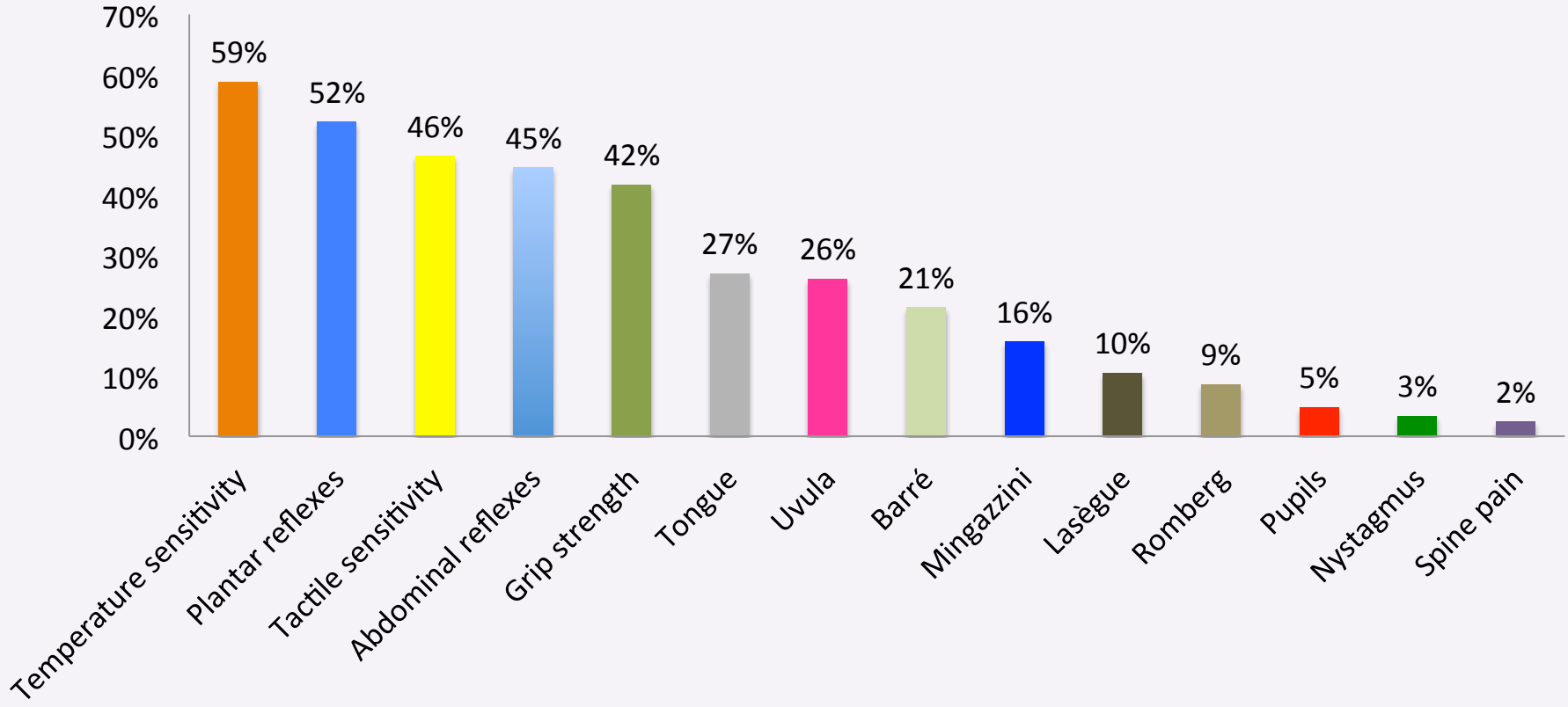


3.3. Other surgical interventions

- **Anterior cervical discectomy and fusion** for cervical disc herniations.
- **Transarticular approach and discectomy** for thoracic disc herniations.
- **Microsurgical or endoscopic discectomy** for lumbar disc herniations.
- **Laminectomy** for spinal stenosis.
- **Radiofrequency thermocoagulation** for facet syndrome.

4. Results of FS®

Early improvements of clinical signs 8 hours postSFT in 211 cases:



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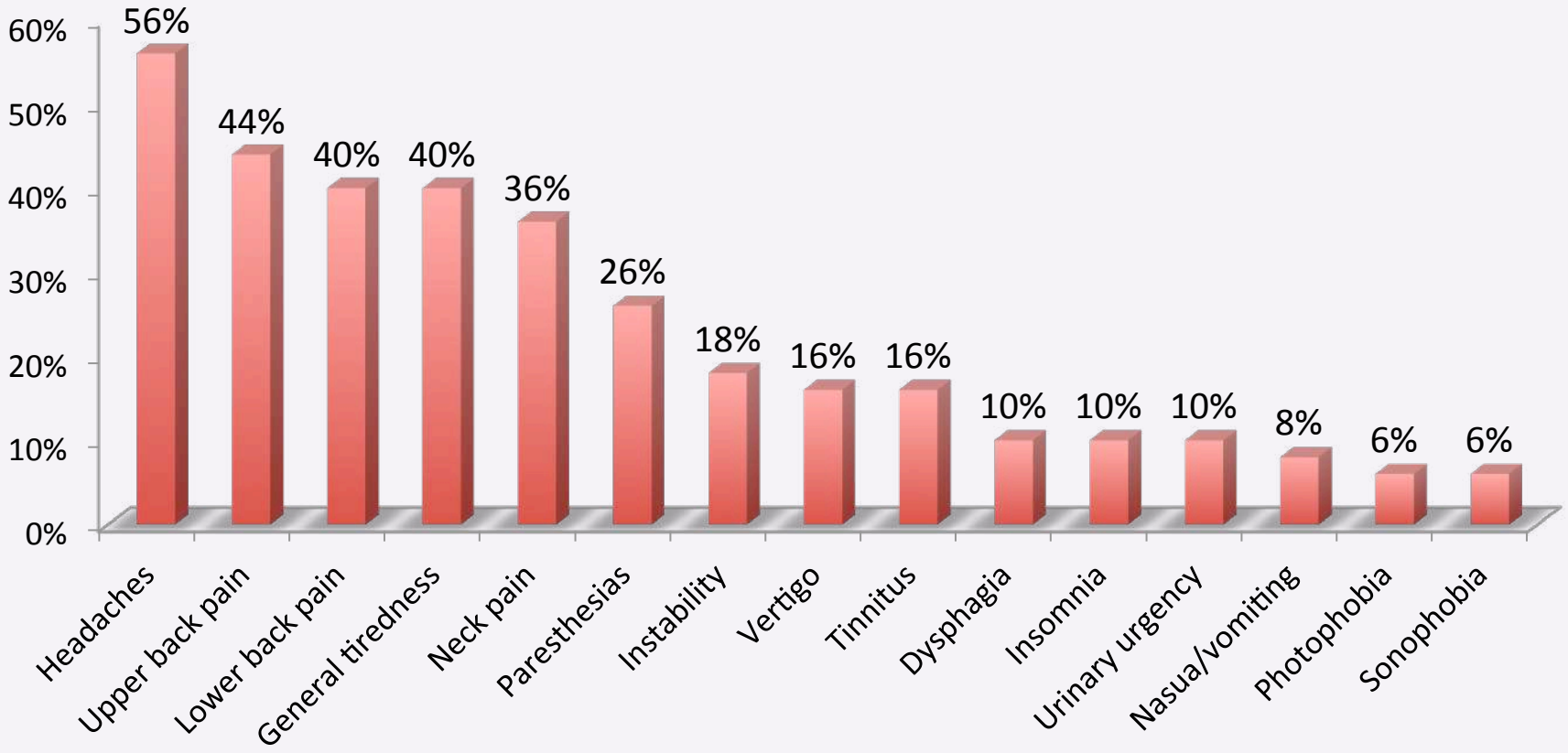
Improvements of clinical symptoms one month postSFT in 50 cases:



Improvements of clinical signs one month postSFT in 50 cases:

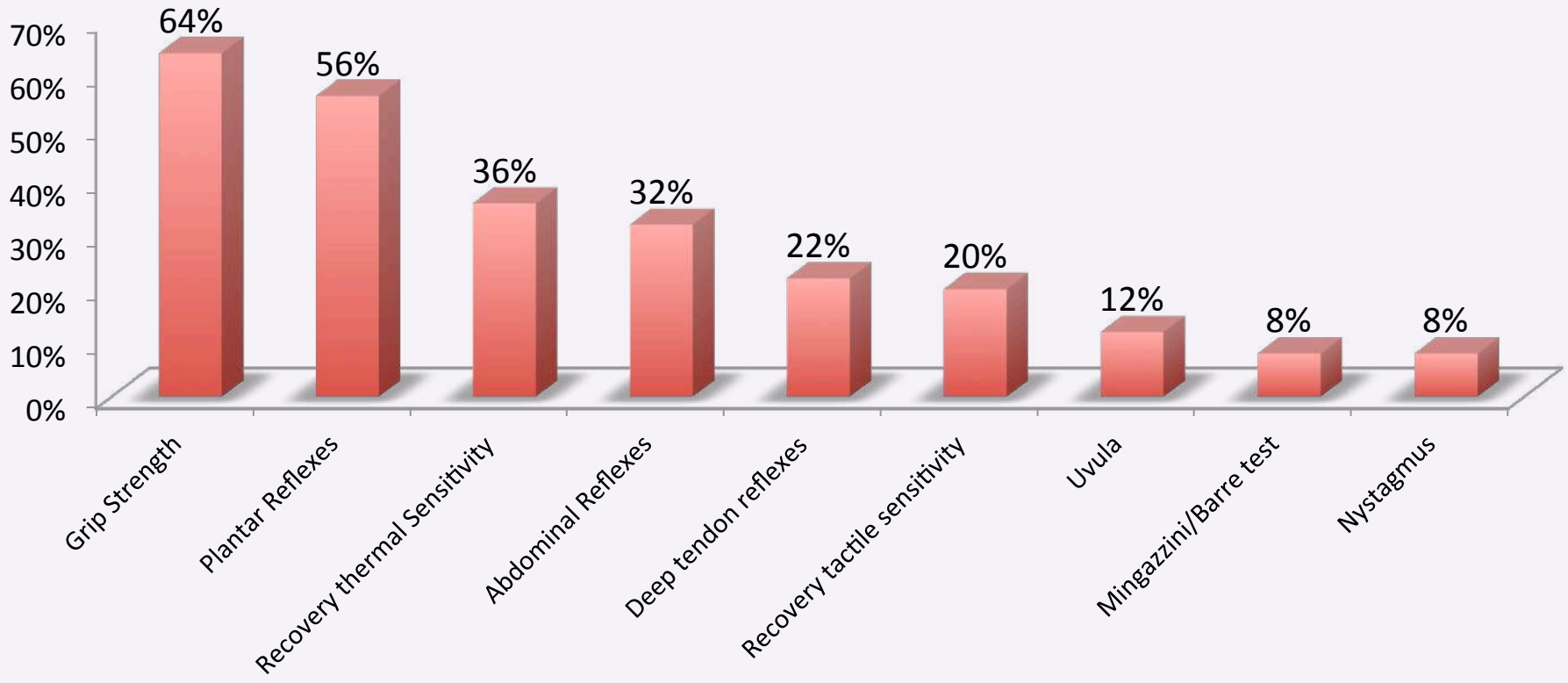


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Image improvements after SFT: less tonsillar descent (1)

2011

2012

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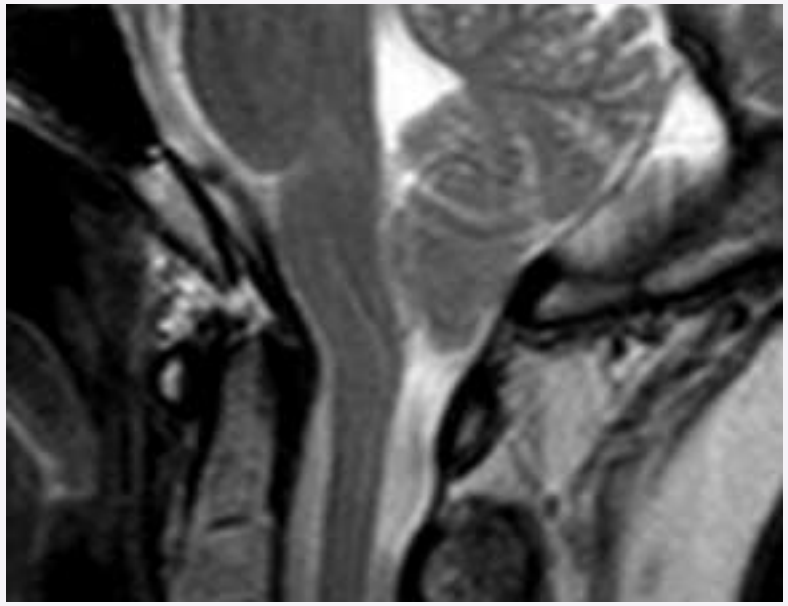
Image improvements after SFT: less tonsillar descent (2)



2012

2013

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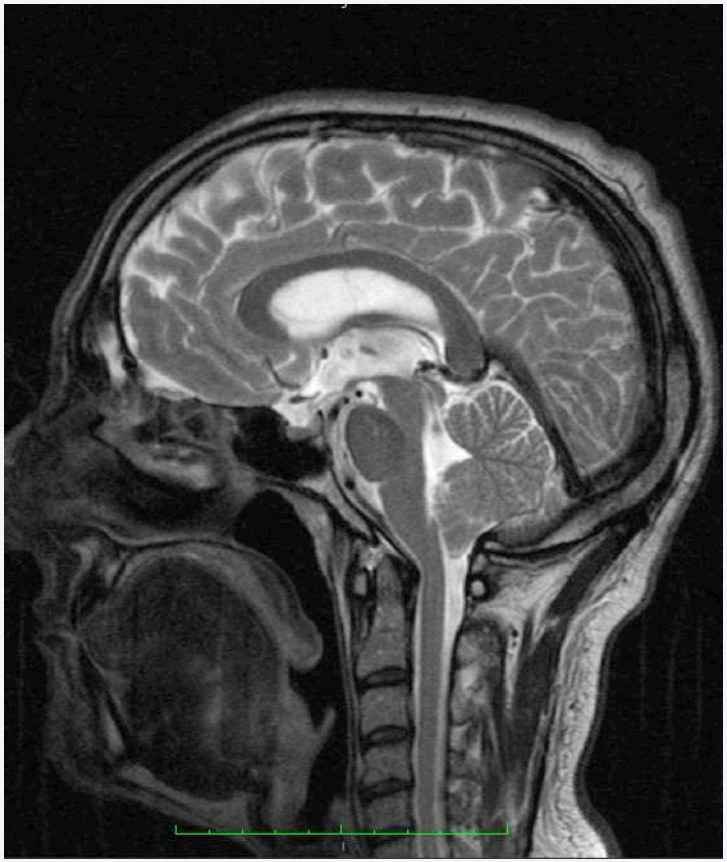
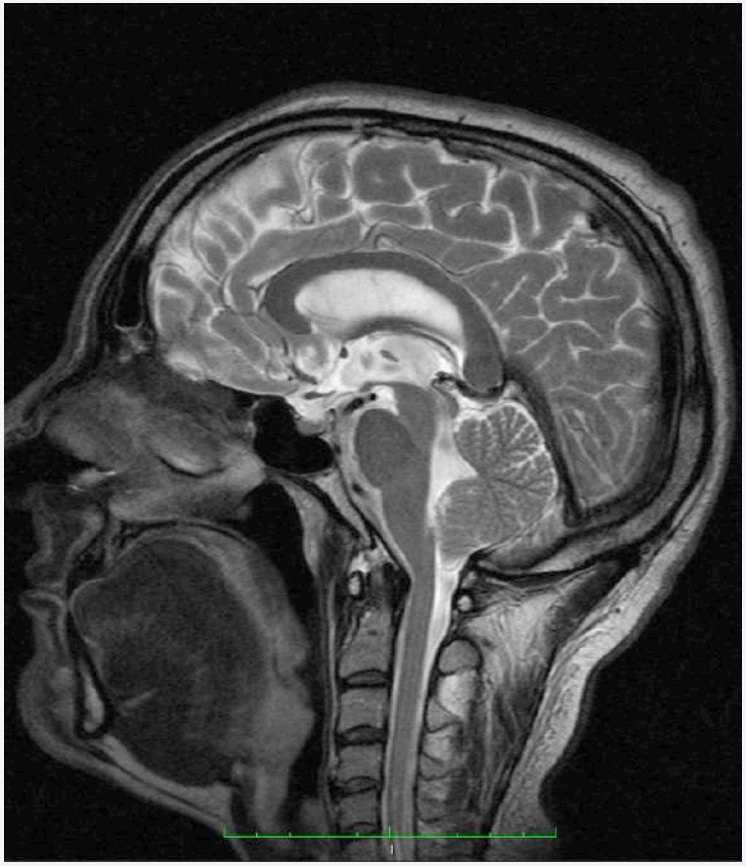
Image improvements after SFT: less tonsillar descent (3)



2008



2010

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Image improvements after SFT: smaller syringomyelia (1)

2006

2014

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Image improvements after SFT: smaller syringomyelia (2)

2009

2010

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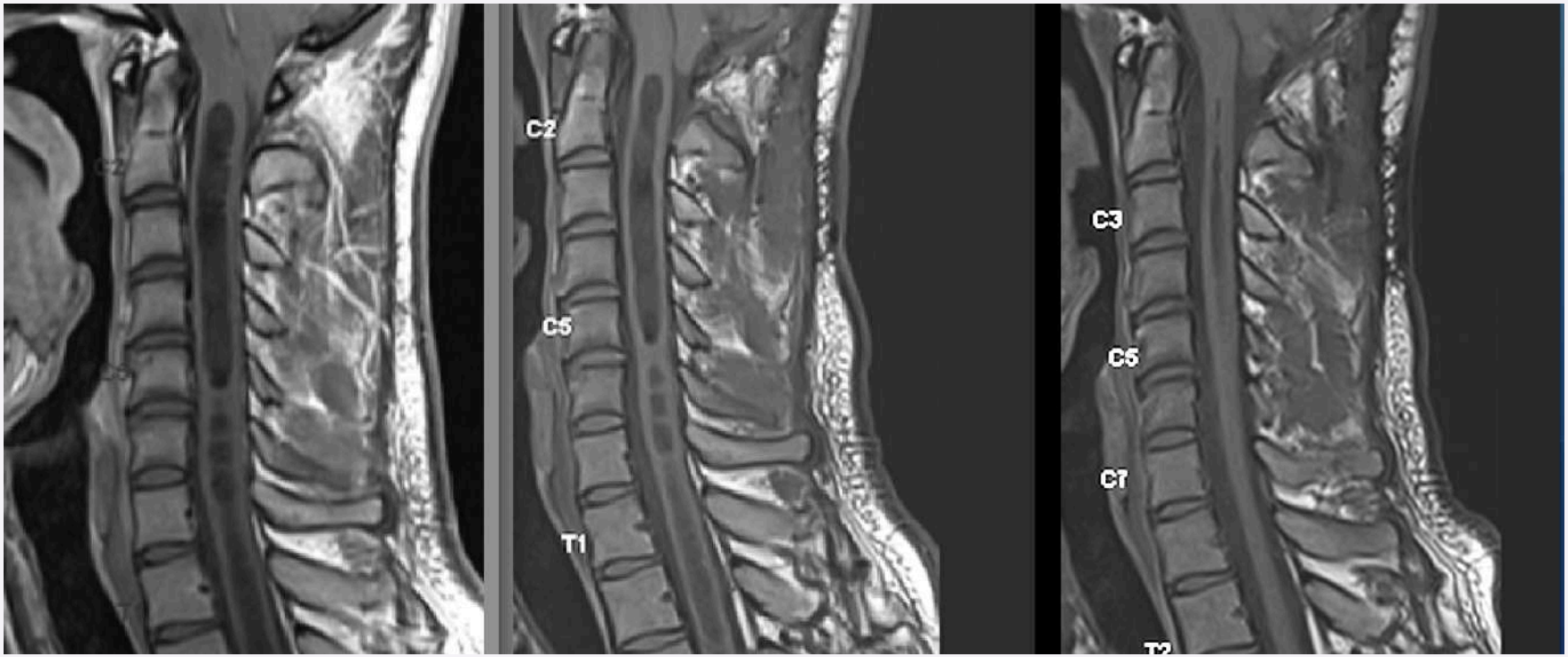
Image improvements after SFT: smaller syringomyelia (3)



2016 **2017** **2019**

Image improvements after SFT: less scoliosis (1)

2001/12.14ºD,16.29ºL

2009/1.84ºD, 10.54ºL

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Image improvements after SFT: less scoliosis (2)

2009

2010

2011

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Image improvements after SFT: less scoliosis (3)

2015

2017

5. Conclusions: Manual Therapy in Filum Disease

Original article

Shortness of *filum terminale* represents an anatomical specific feature in fibromyalgia: a nuclear magnetic resonance and clinical study

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Angelo Iovane[3]

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KEY WORDS: anatomical modification, fibromyalgia impact questionnaire, fibromyalgia assessment status, mini-invasive surgery, musculo-skeletal disorder, physical therapy.

Summary

***Background*: we aimed to assess whether shortness of *filum terminale* (FT) can represent a specif-**

Introduction

Filum terminale (FT) is a strand of fibrous tissue about 20 cm long and made of two parts: *filum terminale internum* and *filum terminale externum*. The former is nearly entirely made of *pia mater*, the innermost meningeal layer, and extends from the *conus medullaris* of the spinal cord to the *cul-de-sac* of the most external meningeal layers, i.e., the arachnoid membrane and the *dura mater*. At this level, it fuses with those meningeal membranes thus making the coccygeal ligament, which fastens the most distal portion of the *medulla* to the *coccyx*. Indeed, the coccygeal ligament is often referred as *filum terminale externum*.
Some diseases affecting FT have been described, including some forms of tumors, mineral deposition and *filum terminale* disease (FD), described in 1996 by Royo-Salvador[1,2]. *Filum terminale* disease is an outcome of the abnormal traction exerted on the spinal cord by a FT shorter that usual. This condition is

MUSCLES, LIGAMENTS AND TENDONS JOURNAL 2015;5 (1):33-37

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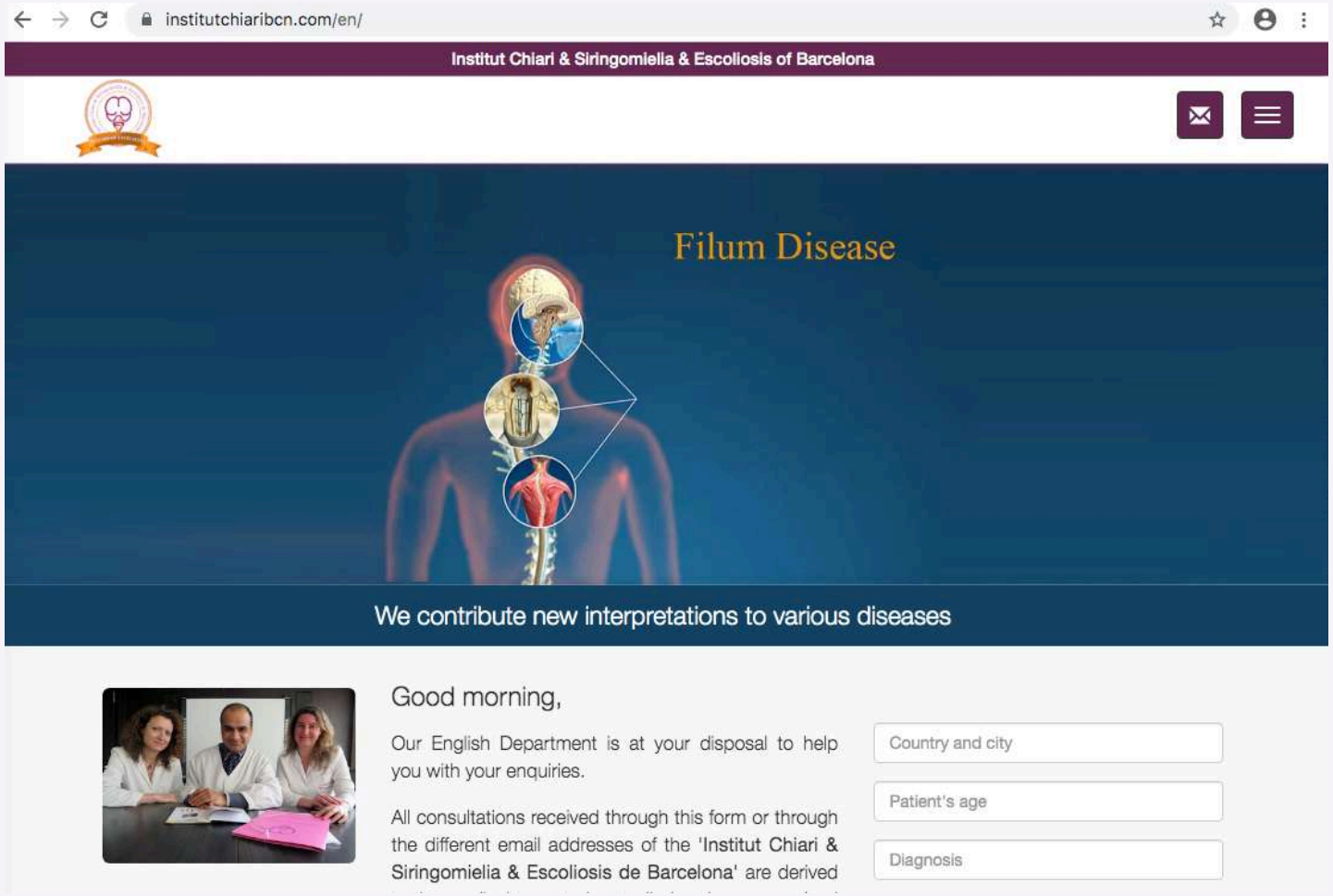

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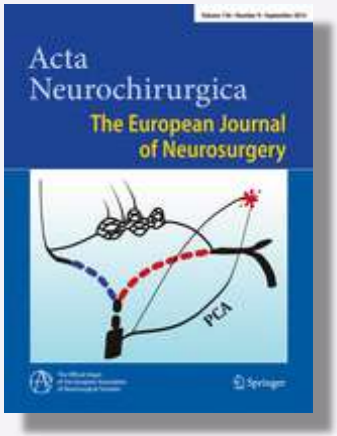

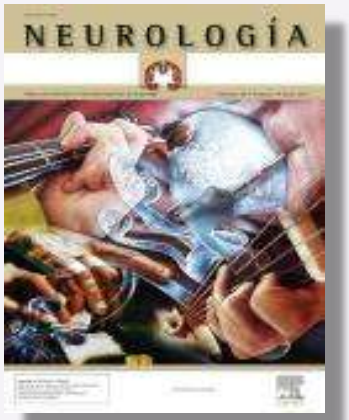

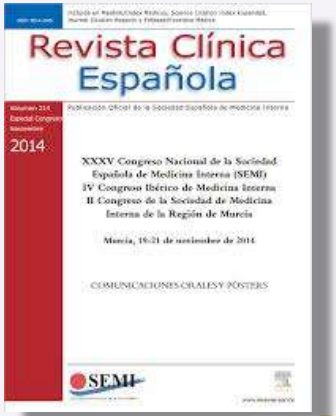

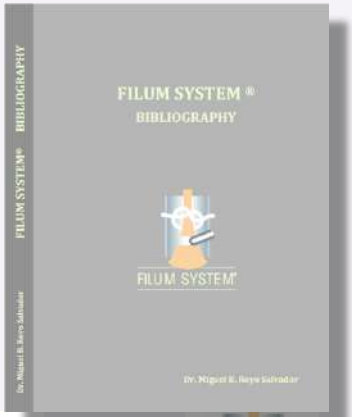

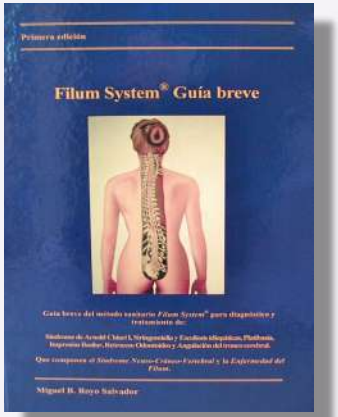

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