

The dimensions of the sacral spinal canal in thecaloscopy: a morphometric MRI study

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ABSTRACT

The subject of this study was the measurement of certain anatomic diameters in the sacral spinal canal by using the lumbosacral MRI studies of 25 patients with unclear pain symptoms, in order to estimate, from the pure anatomic point of view, the capability to perform thecaloscopy in this anatomical region.

Since now anatomic morphometric data of the sacral region were delivered only from the cadaver specimens' sectioning performed in anatomic institutes during the 60's and 70's years.

The parameters measured were: 1) the inclination of the lumbosacral angle, 2) the dural sack's end, 3) the length of all the sacral spinal processes, 4) The length of the sacral spinal canal in its centre, and 5) The width of the sacral hiatus.

The results of the measurements were in detail presented and an evaluation of them concerning the applicability of flexible endoscopes in the sacral spinal canal was performed. It was proven that the dural sack's end in 40% of the patients at the middle of the S2 vertebral body lies, an anatomical position, which through the sacral hiatus easy to access is. The length under the sacral spinal processes is smaller than the length of the sacral spinal canal in its centre, a fact that makes the manipulation of a flexible endoscope easier, if someone works straight under the spinal processes and has a smaller distance to run. Through the sacral hiatus the introduction of the flexible endoscope is by many patients possible because of its adequate width. © *Neuroanatomy*, 2009; 8: 1–3.

Key words [sacrum] [diameters] [morphology] [endoscopy] [thecaloscopy]

Introduction

Two thirds of the adult population is at least once in their life affected by back pain. This pain, as is usually described by the patients, stands in closer sense for complaints of the lower lumbar spine and/or of the lumbosacral transition [1]. Back complaints, mainly in the form of lumboischialgic pain, have themselves since the 20's years turned to be the most expensive musculoskeletal diseases in the industrialized countries [2]. Therefore is the scientific interest in further diagnostics and therapy of these patients large. This corresponds particularly in patients, who revealed no pathological findings in the conventional diagnostic studies. New diagnostic and therapeutic methods were become necessary and minimal invasive neurosurgical procedures have been developed, in order to face this problem, such as neuroendoscopy and thecaloscopy [3–6].

Thecaloscopy is the endoscopy of lumbar subarachnoid space performed through different approaches in the lumbosacral spinal canal by using flexible endoscopes. For thecaloscopy there are many approach possibilities available, such as translumbar (L3–L4 level) and transsacral (S1–S2 level or through the sacral hiatus) [6–8].

The knowledge of the morphometric anatomic dimensions of this region is a precondition for the atraumatic use of flexible endoscopes. Furthermore, by using MRI studies the determination of age- and sex-specific mean anatomic morphometric values of the sacral spinal canal

is possible without the use of cadaver measurements. The measurement values, which originated in the past years particularly from the sectioning of cadavers, were representing actually only one age group, these beyond of 7th decade of life.

The goal of this study was to prove that transsacral endoscopy, from the pure anatomic site of view, is possible.

Material and Methods

During the time period between 01/01/2003 to 12/31/2003 in the Neurosurgical Department of the Paracelsus Clinic (Zwickau, Germany) 25 patients with non-specific back pain were examined in a prospective study by means of lumbosacral MRI studies. The study included 10 females and 15 males. The mean age was 53.36 years. The male mean age with standard error was 53.13±15.64 and the female 53.7±18.27. The confidence limits for the males were 45.21–61.05 and for the females 42.4–65.0.

By using MRI studies, the following parameters were determined: 1) The inclination of the lumbosacral angle, 2) The end of the dural sack referred to the bony structures, 3) The length of all sacral spinal processes, 4) The length of the sacral spinal canal in its centre, and 5) The width of the sacral hiatus (Figure 1).

The measurements of the digitized MRI studies were performed by using the Dicom Program. All the measurements were accomplished in mm. The projection of the end of the dural sack referred to the bony structures

Table 1. Descriptive values for all parameters (n=25).

	Mean (Std.Dev)	Range (Min-Max)
Age (years)	53.36 (16.37)	(17-78)
Lumbo-sacral angle (degree)	141.20 (11.21)	(115-165)
Length sacral spinal processes (mm)	79.45 (14.32)	(58.59-116.62)
Length sacral spinal canal (mm)	59.03 (15.31)	(38.38-104.36)
Width sacral hiatus (mm)	22.12 (4.48)	(13.85-32.21)

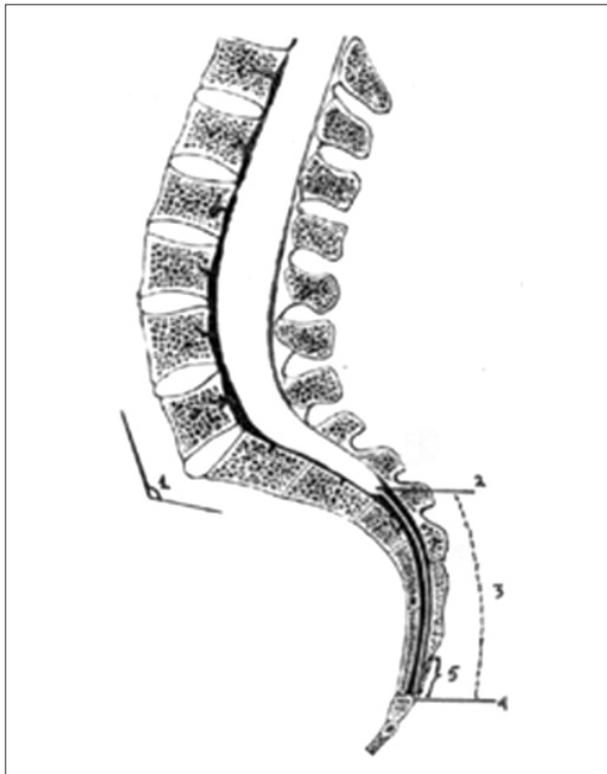
Table 2. Statistical comparison. (Mann-Whitney test)

	Male (n=15)	Female (n=10)	
	Mean (Std.Dev)	Mean (Std.Dev)	p
Lumbo-sacral angle (degree)	142.67 (12.08)	139.00 (9.94)	0.367
Width sacral hiatus (mm)	21.92 (5.00)	22.43 (3.81)	0.567

Table 3. Statistical comparison. (Wilcoxon Signed Ranks test)

	Mean (Std.Dev)	Range (Min-Max)
Length sacral spinal processes (mm)	79.45 (14.32)	(58.59-116.62)
Length sacral spinal canal (mm)	59.03 (15.31)	(38.38-104.36)
Paired differences	20.42 (9.50)†	(16.50-24.34)

(† $p < 0.001$)

**Figure 1.** The anatomic measurements performed.

took place with an approximation of 0, 50 or 100, for the craniocaudal expansion of one given vertebral body. A duralsack's end of S2/50 means that the end of the duralsack, at the middle of the S2 vertebral body lies. The statistic analysis performed using the program SPSS 10.0 for Windows. Due to the small sample and to the fact that the variables weren't following the normal distribution, the non-parametric statistics were used to find out if any difference existed or not. The statistical significant level for the tests was $p=0.05$. The results of the measurements are presented in Table 1.

Results

The 60% of the patients were males and the 40% females. The 44% of the patients were in the age between 46-60 years. The mean value of the lumbosacral angle was 141.2 degrees and for the 40% of the patients this angle ranged between 136-140 degrees. The end of the duralsack was located for 10 patients in the middle of S2 vertebral body (40%) and for 7 patients at the level of the inferior end plate of the S2 vertebra (28%). The length of the sacral spinal canal in its centre for 12 patients ranged between 71-90 mm (48%) and for 7 patients between 50-70 mm (28%). The length of all the sacral spinal processes ranged for 10 patients between 51-65 mm and for 8 patients between 35-50 mm. The width of the sacral hiatus was 21.92 ± 5 mm for the males and 22.42 ± 3.81 mm for the females.

The statistic analysis (Mann-Whitney test) has proved that there is no statistically significant difference between both sexes for the lumbosacral angle's inclination ($p=0.367$) and for the width of the sacral hiatus ($p=0.80$) (Table 2). Further analysis (Wilcoxon Signed Ranks Test) has shown that the length of altogether the sacral spinal processes smaller than the length of the sacral spinal canal in its centre is (Table 3).

Discussion

Back pain is for patients, physicians and social insurance companies a very important issue. Many and different diagnostic and therapeutic procedures have been developed in the latter twenty years. Great interest lies in minimal invasive methods and particularly in endoscopic procedures, which include extradural and intradural exploration techniques [3,6].

The lumbosacral angle is considered as a theoretical reason for back pain symptomatology. In this study the lumbosacral angle was measured for another reason: the anatomical possibility for transsacral endoscopy through the sacral hiatus to prove. From our study we could state that the prevalence age for back pain, in the age group between 45 and 60 years stands, although these pain by young persons or by adults is also reported. This result agrees with the study of Bratton [9]. This is also the age group, in which the cumulative effects of the spinal column movements present and pain symptoms begin.

For the transhiatal approach the length of all sacral spinal processes, the duralsack's end and the width of the sacral hiatus are important. The length under the sacral spinal processes smaller than this of the centre of the sacral spinal canal is. Thus, when someone the endoscope directly under the sacral spinal processes employs, can

it further higher manipulate and the duralsack meet and dot, without the entire width of the sacral spinal canal to use. A mean difference of 20 mm between the length of the sacral spinal canal in its centre and the length under the sacral spinal processes is important, because the “feeling” of the surgeon and the navigation of the endoscope is better, if the distance to run is smaller. In 68% of the patients the dural sac ends at the level of S2 vertebra. The distance from the sacral hiatus to the duralsack’s end, ranges from 35 to 95 mm, and is smaller than in cases where the dural sac at a higher level ends. Finally, the width of the sacral hiatus is large enough in both sexes for the passage of the flexible endoscope. The

lumbosacral angle is simple to pass, because no smaller than 125° and no larger than 165° is. From this study we conclude that in most cases transsacral endoscopy is possible to perform since many of every individual anatomy permits it.

Conclusions

The endoscope can through the sacral hiatus over a length ranging between 35-95 mm in the sacral spinal canal, be introduced. The lumbosacral angle is simple to pass, because no smaller than 125° and no larger than 165° is. No further means needs to be undertaken during thecaloscopy, since no statistically significant difference between sexes for the measured diameters exist.

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