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The neurophysiological significance of perineal descent

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Abstract. The establishment of a linear relationship between perineal descent (PD) and pudendal nerve motor terminal latency (PNMTL) is important in understanding the pathophysiology of pudendal neuropathy. The amount of stretching of the pudendal nerve resulting from the extent of PD, should correlate with the amount of injury sustained (PNMTL). The two key previous studies which used different techniques to measure PD, have differed on this vital issue. A prospective study was undertaken in 141 consecutive patients with PD (M:F=57:84; mean age 46.3 SEM 1.6 years) to clarify this discrepancy. The patients had chronic constipation (81), neurogenic faecal incontinence (31), rectal mucosal prolapse (17) or female urinary stress incontinence (9). All underwent measurements of PD (by perineometry), anal sphincter pressures, single fibre anal sphincter electromyography and PNMTL. These variables, as well as age were analyzed for a linear relationship with PD by multiple regression analysis. Age was the only independent variable predicting PD at rest ($T=-3.2$; $p<0.005$). PNMTL was the only independent variable predicting PD on straining ($T=-3.0$; $p<0.005$). In conclusion, a linear relationship between PD on straining and PNMTL was confirmed, supporting the previous study which also measured PD by perineometry. The other study which refuted such a relationship measured PD radiologically, and it is likely that the difference was in the measurement technique.

Résumé. La mise en évidence d'une relation linéaire entre la descente périnéale (PD) et le temps de latence du nerf honteux interne (PNMTL) est importante dans la compréhension de la physiopathologie d'une neuropathie du nerf honteux. La mesure de l'étirement du nerf honteux résultant d'une augmentation de la descente du périnée doit corréler avec l'importance de l'atteinte nerveuse (PNMTL). Les deux études clé précédentes qui utilisaient différentes techniques de mesure du périnée descendant étaient divergentes quant à cette conclusion essentielle. Une étude prospective a été entreprise sur 141 patients consécutifs avec un périnée descendant afin d'éclaircir cette divergence (M:F=57:84; age moyen 46.3 en ± 1,6). Les patients souffraient de constipation chronique (81), d'incontinence fécale neurogénique (31), de prolapsus muqueux rectal (17) ou d'incontinence urinaire de stress chez la femme (9). Dans tous les cas, on a réalisé une mesure du périnée descendant par périnéométrie, des mesures des pressions sphinctériennes, une électromyographie à fibre unique des sphincters et une mesure du temps de latence du nerf honteux interne. Ces variables de même que l'âge ont été étudiés par une analyse à régression multiple afin de mettre en évidence une relation linéaire avec le périnée descendant. L'âge est la seule variable indépendante qui prédise un périnée descendant au repos ($T=3,2$, $P<0.005$). Le temps de latence du nerf honteux interne était la seule variable prédisant le périnée descendant à l'effort ($T=3.0$, $P<0.005$). En conclusion, nous pouvons confirmer une relation linéaire entre le périnée descendant, l'effort d'exonération et le temps de latence du nerf honteux interne confirmant en cela une étude antérieure qui confirme également le périnée descendant par périnéométrie. L'autre étude qui réfutait une telle relation n'était établie que sur une mesure radiologique du périnée descendant, aussi est-il probable que la différence résulte de la technique de mensurations.

Abnormal perineal descent (PD) occurs when the weakened pelvic floor lies at a lower level than normal. It is a common clinical finding in anorectal disorders such as constipation, incontinence, rectal pain and solitary rectal ulcer syndrome [1–3]. The cause is thought to be excessive repeated straining which forces the anterior rectal wall to protrude into the anal canal. This creates a sensation of incomplete defaecation and weakens the pelvic floor [4]. The sensation of incomplete evacuation in turn causes more straining and a vicious cycle is established [5].

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Present evidence implicates that pudendal injury is the major cause of anal sphincter weakness and faecal incontinence. This includes abnormal single fibre electromyography [6, 7], histopathologic changes [8–10] and prolonged pudendal nerve motor terminal latencies (PNMTL) [11, 12]. As abnormal PD and pudendal neuropathy are commonly present in patients with defaecation disorders, it has been suggested that denervation of the anal sphincter muscles may have resulted from entrapment or stretch injury to either the pudendal or perineal nerves from PD [1, 7, 8, 11, 13–15]. Excessive PD can result in an increase in the length of the pudendal nerves by as much as 20 percent, an amount sufficient to cause neuropathy [16, 17].

A linear relationship between PD and PNMTL would support this "entrapment and stretch" theory of pudendal neuropathy. Of the two studies to date addressing this issue, one proves [18] and the other refutes [19] such a relationship. Therefore, we performed this prospective study to verify whether the amount of PD would predict PNMTL and anal sphincter dysfunction.

Patients and methods

Patients

One hundred and forty-one consecutive patients with abnormal PD were recruited. There were 57 males and 84 females, with a mean age of 46.3 SEM 1.6 years. The clinical diagnoses are shown in Table 1. None of these patients had any evidence of systemic neurological disease.

Anal manometry

This was performed using a Synectics (Stockholm) microcapillary perfusion system which perfused (rate of 0.5 ml min^{-1} distilled water) a flexible 4.8 mm diameter, four channel polyvinylchloride catheter with ports set at 90° radially apart at the same level from the tip [20]. A station pullthrough technique was employed monitoring the pressures at each 1 cm interval. The pressures measured at each station were averaged out over the four directions sampled.

Perineal descent

PD was measured using a perineometer in the standard manner [1]. With the patient in the left lateral decubitus position, the level of the perineum at the anus was measured in relation to the ischial tuberosities, both at rest and on maximum defaecation straining.

PNMTL

PNMTL was determined with a St. Mark's pudendal electrode connected to a Dantec (Skovlunde) Neuromatic 3000 M electromyography machine, which provided stimulated of the pudendal nerve and recording of the resulting external anal sphincter action potential [12].

Fibre density (FD)

This was done by inserting a sterilized single fibre needle electrode into the external anal sphincter [6]. Analysis was performed on 20 serial recordings of different single muscle fibres.

Statistics

Statistical significance was tested by using analysis of variance, Pearson correlation and multiple regression [21], as appropriate.

Results

Anorectal physiology

The findings are shown in Table 1. There was no difference in the mean resting pressure (MRP), maximum voluntary contraction (MCV), PD at rest and on straining, FD or PNMTL between the chronic constipation, neurogenic faecal incontinence, rectal mucosal prolapse and urinary stress incontinence groups of patients.

Table 1. Anorectal physiology in perineal descent patients ($n = 141$)

	Constipation[a]	Neurogenic faecal incontinence[a]	Rectal mucosal prolapse[a]	Female urinary stress incontinence[a]
n	84	31	17	9
Age (years)	49.7 ± 1.7	47.8 ± 2.7	49.6 ± 2.7	40.9 ± 4.2
Male:Female	35:49	12:19	10:7	0:9
MRP (mmHg)	60.4 ± 2.9	53.3 ± 6.4	63.4 ± 4.9	63.5 ± 9.2
MVC (mmHg)	120.7 ± 6.5	119.5 ± 12.4	143.4 ± 12.1	109.7 ± 16.9
RPD (cm)	1.1 ± 0.1	1.3 ± 0.1	1.7 ± 0.8	1.8 ± 0.1
SPD (cm)	0.1 ± 0.1	–0.5 ± 0.7	0.4 ± 0.8	–0.4 ± 0.3
FD	1.5 ± 0.03	1.5 ± 0.05	1.4 ± 0.05	1.3 ± 0.06
PNMTL-R (ms)	2.3 ± 0.1	2.3 ± 0.1	2.1 ± 0.1	2.1 ± 0.1
PNMTL-L (ms)	2.3 ± 0.1	2.4 ± 0.1	2.2 ± 0.1	2.4 ± 0.2

MRP, mean resting anal pressure; MVC, maximum voluntary anal contraction pressure; RPD, resting perineal descent; SPD, straining perineal descent; FD, fibre density; PNMTL-R, right pudendal nerve motor terminal latency; PNMTL-L left pudendal nerve motor terminal latency

[a] Mean ± SEM

Table 2. Correlation between perineal descent and anal sphincter function/pudendal nerve motor terminal latency (PNMTL)

	Variable	r value	*p*
Perineal descent at rest	Age	–0.301	<0.001
	Mean resting pressure	–0.018	NS
	Max. voluntary contraction	0.058	NS
	Fibre density	–0.155	NS
	PNMTL	–0.248	<0.01
Perineal descent on straining	Age	–0.080	NS
	Mean resting pressure	–0.148	NS
	Max. voluntary contraction	0.201	NS
	Fibre density	–0.018	NS
	PMTL	–0.283	<0.01

NS, not significant

Table 3. Multiple regression analysis of factors predicting resting perineal descent (RPD)

RPD = 1.9 – 0.01 (age)
R^2 = 0.09
Standard error = 0.6

Factors evaluated

	T
Age	–3.2*
Pudendal nerve terminal motor latency	–1.8
Fibre density	–1.7
Maximum voluntary contraction	0.8
Mean resting pressure	–0.5

p < 0.005

Table 4. Multiple regression analysis of factors predicting straining perineal descent (SPD)

SPD = 1.2 – 0.6 (PNMTL)
R^2 = 0.08
Standard error = 0.7

Factors evaluated

	T
Pudendal nerve terminal motor latency (PNMTL)	–3.0*
Maximum voluntary contraction	1.7
Mean resting pressure	1.2
Fibre density	0.3
Age	0.1

* *p* < 0.005

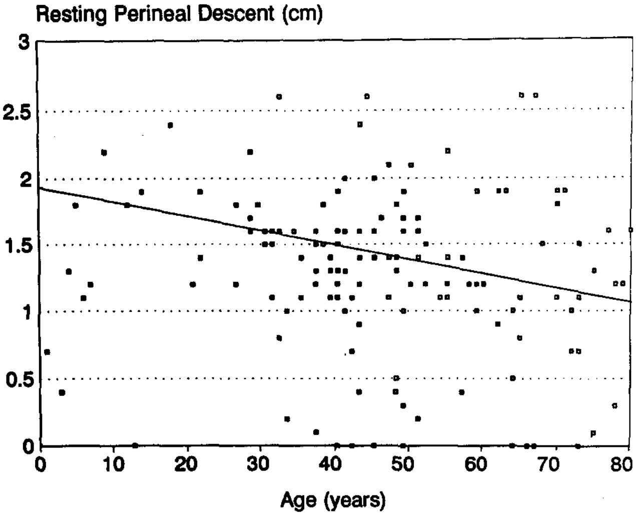

Fig. 1. Relationship between age and resting perineal descent (R^2 = 0.09; r = –0.301, P < 0.01)

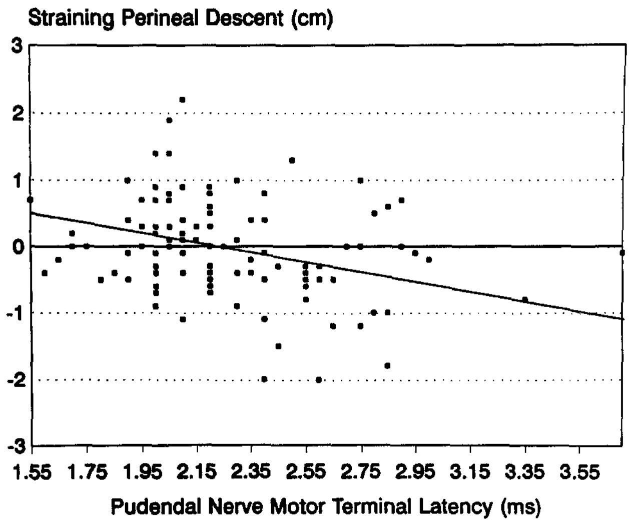

Fig. 2. Relationship between pudendal nerve motor terminal latency and straining perineal descent (R^2 = 0.08; r = –0.283; p < 0.01)

Correlation between PD and sphincter function/PNMTL

The correlation between PD (at rest and on straining) and sphincter function (MRP, MVC, FD)/PNMTL is shown in Table 2. PD at rest correlated significantly with age (r = –0.301; P < 0.001) and PNMTL (r = –0.248; p < 0.01). PD on straining correlated significantly with PNMTL (r = –0.283; p < 0.01).

Multiple regression analysis

Age independently predicted PD at rest (Table 3, T = –3.2, p = 0.002; Fig. 1) and PNMTL independently predicted PD on straining (Table 4, T = –3.0, p = 0.003; Fig. 2).

Discussion

The confirmation of a linear relationship between PD and PMTL is important evidence to support the "entrapment and stretch" theory of pudendal neuropathy. Abnormal PD is found in about 75% of patients who habitually strain at stools, although the effect upon continence is variable [22]. According to the above theory, the pudendal nerves are normally tightly bound by connective tissue as they exit from the pelvis to the pudendal canal, angulating around the ischial spine [8, 23, 24]. Therefore, descent of the perineum during child-birth or chronic prolonged evacuation can cause stretch to the nerves at this point. In our study a significant correlation between PD on straining and PNMTL was found. (PNMTL is a measurement of the fastest motor conduction in the pudendal nerve [18] and relates reliably to neuropathy [25–27].) The mean bilateral value of PNMTL was used for correlation as asymmetric PNMTL is not an uncommon finding [28, 29]. The findings of Jones et al. [18] in 60 patients with neurogenic faecal incontinence was therefore confirmed.

However, Jorge et al. [19] found no correlation between PD and PNMTL in 213 patients, and these results have questioned the neurophysiological significance of PD. Unlike Jones et al. [18] who measured PD by perineometry, PD was measured by cineradiological methods in the latter study. Cinedefaecography has the advantage of examining the patient in the more normal position on the toilet seat (seated with both hips and knees flexed), compared with the left lateral decubitus position employed in perineometry. Theoretically the cinedefaecography measurements at straining can also be confirmed by observing actual rectal evacuation of contrast. However, in our experience, the accurate identification of the bony and soft tissue landmarks required to measure PD on x-rays is often difficult. We are not aware of any studies which have compared the results of measuring PD by perineometry and cinedefaecography. Our findings confirm the relationship between straining PD and PNMTL. Straining PD increased with prolonged PNMTL. This suggests that the discrepancies may have been the result of different techniques in measuring PD.

On multiple regression analysis, age was the only independent variable which predicted the amount of PD at rest. PD at rest increased with older age. Such a trend has been reported in previous studies, but only found statistically significant in the subset of female patients [19, 30, 31]. Although PNMTL correlated with PD at rest in our study, this relationship was not significant on multiple regression analysis. This is consistent with previous published results [19, 32]. Age is important in the pathophysiology of pelvic floor weakness [33], and our results suggest that it is likely to be the main factor influencing PD at rest.

There was no correlation between PD and anal sphincter function in our study. Previous reports have shown no significant differences in anal pressures between controls and patients with abnormal PD [1]. It is possible that the neurological injury associated with PD does not clinically manifest in incontinence (due to physiological reserves) until a critical threshold is reached.

In conclusion, the PD at straining measured by perineometry correlated significantly with PNMTL. The previous report [18] using a similar methodology, though with less patients was confirmed. The traditional "entrapment and stretch" theory of pudendal neuropathy was supported. Our findings suggest that the PD measurements made by cineradiology may be different from those by perineometry. Further studies comparing the results of both these techniques are required.

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