

## IS INJURY TO THE LEVATOR ANI NERVE PREVENTABLE IN RECTAL SURGERY?

### Hypothesis / aims of study

The incidence of faecal incontinence after total mesorectal excision (TME) for rectal cancer is high (1, 2). In surgical literature much attention has been devoted to the hypogastric nerves. In contrast, much less attention has been paid to the surgical anatomy and innervation of the levator ani muscle. Also damage to these nerves is less emphasized. We have studied the surgical anatomy of the nerves to the levator ani, and postulate that surgical denervation of the muscle probably contributes to faecal incontinence after rectal surgery.

### Study design, materials and methods

To establish the presence of a levator ani nerve (LAN) we studied histochemically stained serial sections of seven male and nine female foetal pelves (10 – 27 weeks of gestation). Additionally, two female foetal pelves (14 & 19 weeks of gestation) were stained immunohistochemically for the presence of striated muscle tissue, using a antibody directed against myosin heavy chain and for the presence of nerve tissue, using a antibody directed against neurofilament 68 kD.

Further, ten male and ten female adult pelves were dissected and the course of the levator ani nerve was described quantitatively. Its relation to the rectum and the pelvic splanchnic nerves was studied. To confirm the macroscopical findings, histology of presumed nerve tissue was studied. Nerve biopsy specimens were taken and stained immunohistochemically.

To study possible surgical damage of the nerves to the levator ani, a TME was performed on two male cadaveric pelves, as this procedure is undertaken more frequently in males than in females in the clinical setting.

### Results

All foetuses and cadavers examined had a LAN. It runs on the inner surface of the pelvic floor directly underneath the pelvic parietal fascia (Fig. 1), approximately 1 cm medial to the ischial spine (Fig. 2). As observed in the foetal sections, the pudendal nerve only had a minor contribution to the levator ani muscle innervation. The LAN was not disrupted during the dissection of the TME procedure on cadavers, because the surgical plane of cleavage lies between the pelvic parietal fascia and the mesorectal fascia (Fig. 3). The surgical dissection plane was separated from the nerve by the thin layer of pelvic parietal fascia only.

### Interpretation of results

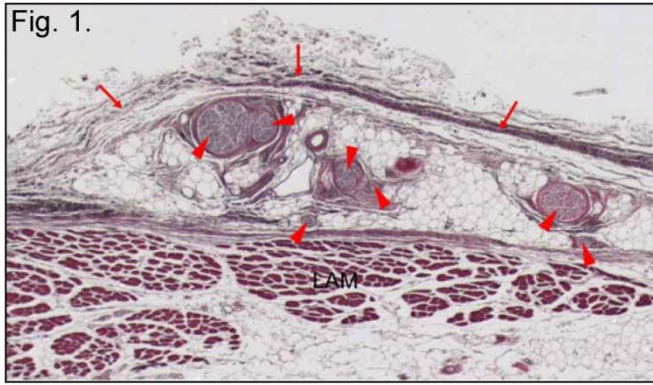
An optimally performed mesorectal excision can save the levator ani nerve. However, a sphincter saving TME in patients with low rectal tumours bears a high risk of levator ani nerve disruption through stapling and/or radiotherapy treatment.

### Concluding message

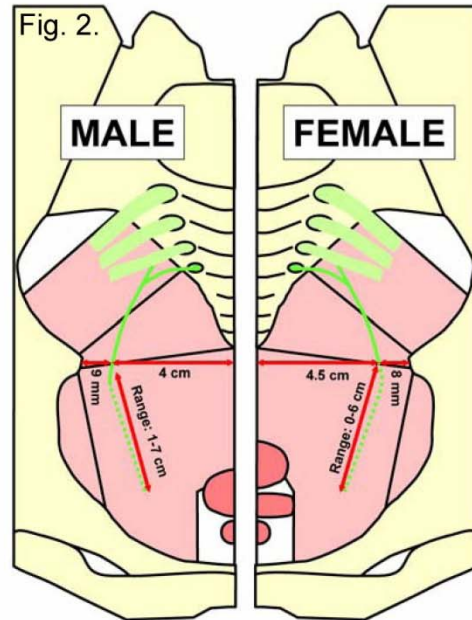
Faecal incontinence after TME has a multifactorial aetiology in which altered compliance of the rectum, denervation of the anal sphincter, quality of the anastomosis and pouch as well as psychological factors probably all play a role. The knowledge that not the pudendal nerve but the vulnerable levator ani nerve is responsible for the motor function of the levator ani muscle adds to our understanding of the causes of faecal incontinence after TME. Accidental disruption of the levator ani nerve during a difficult surgical procedure is a factor to which greater attention needs to be paid.

### References

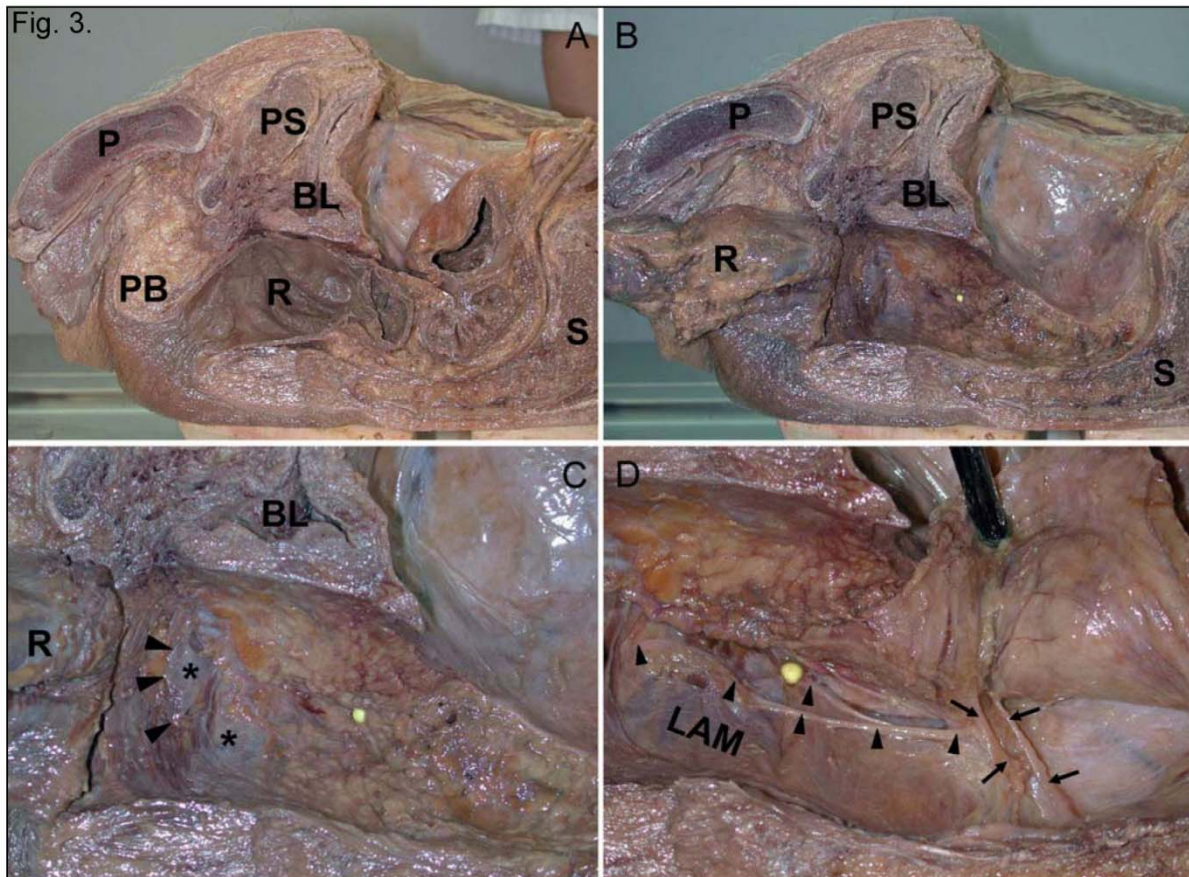
1. J Clin Oncol (2005) 23: 6199-206
2. Gastroenterol Clin Biol. (2004) 28(2):155-9



**Fig. 1.** Histological section of the levator ani nerve branches (arrowheads) running on top of the levator ani muscle (LAM) but underneath the parietal fascia (arrows). Section was taken medial to the ischial spine.



**Fig. 2.** Schematic overview of the course of the levator ani nerve (green) in the male and female pelvis.



**Fig. 3.** Total mesorectal excision (TME) on a midsagittally transected male pelvis. **A.** Medial view of the complete hemipelvis. **B.** Hemipelvis after TME was performed. The rectum is still attached to the anus and flipped out, over the perineal body. **C.** Enlargement of the rectal space of image B. Note that the parietal fascia (asterisks) was removed in its most caudal part (arrowheads represent the edge of the still present part of the parietal fascia). **D.** The levator ani nerve (arrowheads). Note that the levator ani nerve has a common origin with the pelvic splanchnic nerves (arrows). BL, bladder; LAM, levator ani muscle; P, penis; PB, perineal body; PS, pubic symphysis; R, rectum; S, sacrum. The yellow pin shows the position of the ischial spine.

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**HUMAN SUBJECTS:** This study did not need ethical approval because only human cadaver specimens were used. and did not follow the Declaration of Helsinki - with approval by the ethics committee - in the sense

that this does not apply to this study since only cadaver specimens were used. Informed consent was not obtained from the patients.