New, Simple Approach for Maximal Pudendal Nerve Exposure

Anomalies and Prospects for Functional Reconstruction


From St. Mark's Hospital and Northwick Park Institute for Medical Research, Harrow, United Kingdom

PURPOSE: Functional neosphincters after pudendal nerve anastomosis proved possible in animal models and may be applicable in humans, but access is a recognized problem. We report the occurrence of pudendal nerve anomalies, its implications for reconstruction, and describe a new approach for maximal exposure. METHODS: Adult human cadavers were positioned prone and dissected via a gluteal approach. Pudendal nerve variations and physical measurements were analyzed statistically. RESULTS: A new, simple, four-step approach (surface landmarks and exposure of gluteus maximus muscle, sacrotuberous ligament, and pudendal neurovascular bundle) permitted optimal pudendal nerve exposure in all 14 human cadavers (28 limbs). Six were males and had a mean age of 82 (range, 58–102) years. Two anomalies, Type 1 (2-trunked) and Type 2 (3-trunked), of the pudendal nerve were recognized in 30 percent of cadavers, with a left-to-right ratio of 2.5:1. Mean pudendal nerve length over the ischial spine was 23.9 (range, 19–28) mm right, 24.2 (range, 19–28) mm left (P = 0.54), but its diameter measured 5.2 mm (right) and 4.9 mm (left; P = 0.04). Mean length of pudendal nerve trunk exposed after reflection of the sacrotuberous ligament was 55 (range, 44–75) mm on either side before division into terminal branches. The number and percent frequency of inferior rectal nerve on both sides were 1 (13 percent), 2 (76 percent), and 3 (11 percent), respectively, with a mean length of 27.1 (range, 21–34) mm right and 27.9 (range, 20–33) mm left (P = 0.31). CONCLUSION: A simple four-step approach to the pudendal nerve contributes to improved access in all cases. It facilitates reconstruction because it allows accurate nerve selection and recognition of potential anomalies that might influence functional outcome. [Key words: Anatomy; Approach; Pudendal nerve; Anomalies; Functional reconstruction; Anal sphincter; Rectal cancer; Fecal incontinence]


Patients' abnormal body image and incontinence contribute primarily to the physical, social, and psychological morbidity attributable to a permanent stoma of the alimentary tract. Reconstruction of the anorectum using either smooth or passive skeletal muscle wraps has been described and remains an alternative for a select group of patients who, it would seem, have preference for the psychological benefit of restored body image against the shortcomings of incontinence. However, despite attempts to improve neosphincter function by electrical stimulation of implantable devices, fecal expulsion and continence control pose formidable challenges, and many patients rely on regular enemas for evacuation. Furthermore, denervation (sensory and motor disruption resulting from surgery) renders the neoanus incapable of normal physiologic function and has hampered efforts toward attaining the ultimate goal of total anorectal reconstruction with normal neural control, without the drawback of abnormal body image.

Much interest has recently been generated by reports in animal studies of functional skeletal muscle neosphincters resulting from cross-innervation of the nerve supplying the transplanted muscle and the pudendal nerve, after rectal excision and experimentally induced fecal incontinence. These studies suggest that the pudendal nerve potentially has a crucial role in attempts to restore native innervation to a variety of reconstructive procedures that might eliminate the need for a permanent abdominal stoma. Although a recent case report of failed functional neosphincter was attributed to infection and ischemia, optimal exposure of pudendal neurovascular structures without tension is an essential step for improved outcome. We embarked on a detailed study of pudendal nerve anatomy in human cadavers, seeking to identify potential anomalies of clinical significance and to describe a new, simple, reproducible approach for maximal exposure of the nerve and its branches.
that might contribute to improved access for functional reconstructive procedures.

MATERIALS AND METHODS

We obtained permission from the head of the Department of Anatomy to dissect and study in detail the anatomy of the pudendal nerve in adult human cadavers preserved in 10 percent formalin. Dissection in all cases to expose the pudendal nerve trunk and its branches (magnified ×3.2 using optical loupes, Carl Zeiss, Germany) was via a gluteal approach, with the cadaver in full prone position.

The pudendal nerve is a mixed nerve, containing sensory, motor, and autonomic fibers from the sacral plexus. Three roots (S-2, S-3, and S-4) arising from the ventral sacral rami unite into two cords that join to form the pudendal nerve, which leaves the pelvis through the greater sciatic foramen and into the gluteal region.

The pudendal nerve trunk and its branches were exposed by blunt dissection along its course within Alcock's canal and traced distally to the termination of its inferior rectal branches on the external anal sphincter. The frequency of occurrence of pudendal nerve trunk anomalies were noted, and physical parameters were recorded. Data obtained were subjected to statistical analysis by calculation of mean, standard deviation, and P value using Student's t-test (unpaired). P values less than 0.05 were considered significant.

RESULTS

We found that the following four steps are a simple approach for maximal pudendal nerve exposure:

- Step 1: The midpoint of the lateral border of the sacrum, the ischial tuberosity, and the ipsilateral greater trochanter of the femur were identified and marked with indelible ink (Fig. 1). These surface landmarks were chosen because they are easily identifiable and define the anatomical region of interest.
- Step 2: A vertical incision through skin and subcutaneous tissue was extended from the mid sacrum to the ischial tuberosity, then curved upwards and laterally to the greater trochanter to create a flap that was reflected to reveal oblique fibers of the distal one-half of glutus maximus arising from its sacral origin, and directed downwards (Fig. 2).
- Step 3: A vertical incision was made through the exposed glutus maximus onto the sacrum and extended distally to the ischial tuberosity so that lateral retraction of this muscle exposed the glistening fibers of the sacrotuberous ligament and inferior gluteal neurovascular bundle arising from its free edge (Fig. 3). It is our view that a straight skin incision alone would not provide adequate exposure of these structures in clinical cases.
- Step 4: The sacrotuberous ligament was then divided at its distal attachment and drawn outwards along its free border to reveal the pudendal neurovascular bundle in a connective tissue tunnel (Alcock's canal), shown in Figure 4.