

# The Accessory Obturator Nerve and the Innervation of the Pectineus Muscle

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There are a number of puzzling circumstances related to the occurrence of the accessory obturator nerve and the innervation of the pectineus muscle. What is the frequency of occurrence of the nerve? What is its pattern of innervation? Does the pectineus muscle belong to the ventral or the dorsal division of the thigh musculature? Is its position in the ventral or the dorsal division reflected in its innervation? Does the muscle have, perhaps, a double derivation?

Eisler (1891) in his discussion of the lumbosacral plexus of man, set the pattern for the current description of the origin, course, and occurrence of the accessory obturator nerve. He reported finding it in 8 of 32 cases, a frequency of 25%. Oddly enough, subsequent references to Eisler's study have consistently attributed to him a 29% occurrence for the nerve. There are relatively few reports in the literature of studies on the accessory obturator nerve, and those that exist are based on small numbers of specimens. De Sousa ('42) reported a 19% occurrence; Kaiser ('49) found it in two of 24 sides, an 8.3% frequency. It is equally obvious that Eisler's sample was too small to give reliable results. Failure to find the nerve nearly so often as reported was the stimulus for a frequency study in this laboratory. Beginning in the summer of 1953, most of the cadavers used in our teaching laboratories were observed for the occurrence and distribution of the accessory obturator nerve. At the termination of the study of 550 sides in 1959, the nerve had been found in 48 specimens, an occurrence of 8.7%. The unreliability of small groups of specimens is apparent in the various segments of this study. One group of 102 sides yielded only three nerves, where-

as another group of 99 sides showed 17 nerves. No group, large or small, approached any closer than this last one to Eisler's sample. A computation half way through the study likewise showed the frequency of occurrence of the nerve to be just under 9%. A statistically reliable study which has not been cited because of its incorporation in an extensive embryological investigation was reported by Bardeen in 1906. He found the accessory obturator nerve to be present in 21 of 250 specimens, a frequency of 8.4%. If our samples were combined, the occurrence of the accessory obturator nerve could be based on 800 sides and would show a frequency of 8.6%.

The small accessory obturator nerve arises from the lumbar plexus by roots from the third and fourth lumbar nerves which emerge between the roots of origin of the obturator and femoral nerves (fig. 1). It parallels the obturator nerve along the medial side of the psoas muscle but runs somewhat more ventrally. Characteristically, the accessory obturator nerve passes deep to the expansion of the psoas minor tendon to cross the superior ramus of the pubis directly on the bone and behind the femoral vein. The nerve descends on the deep or dorsal aspect of the pectineus muscle and divides in the interval between this muscle and the capsule of the hip joint. Typically the nerve breaks up into three branches: one enters the front of the capsule of the hip joint; one passes medially to anastomose with the anterior branch of the obturator nerve; and one penetrates the dorsomedial aspect of the pectineus muscle to supply a portion of that muscle. One or other of these parts may be lacking, and, on occasion, there are additional branches of the nerve. A

twig to adductor longus is not too uncommon.

When present, the accessory obturator nerve supplies a portion of the pectineus muscle, entering the muscle on its dorso-medial aspect. The greater nerve to the muscle, even when the accessory obturator is present, is a medially placed branch of the femoral nerve. This nerve is never lacking and provides the sole innervation in over 90% of cases. It usually arises from the femoral nerve just distal to the inguinal ligament and turns medialward dorsal to the femoral artery and vein and

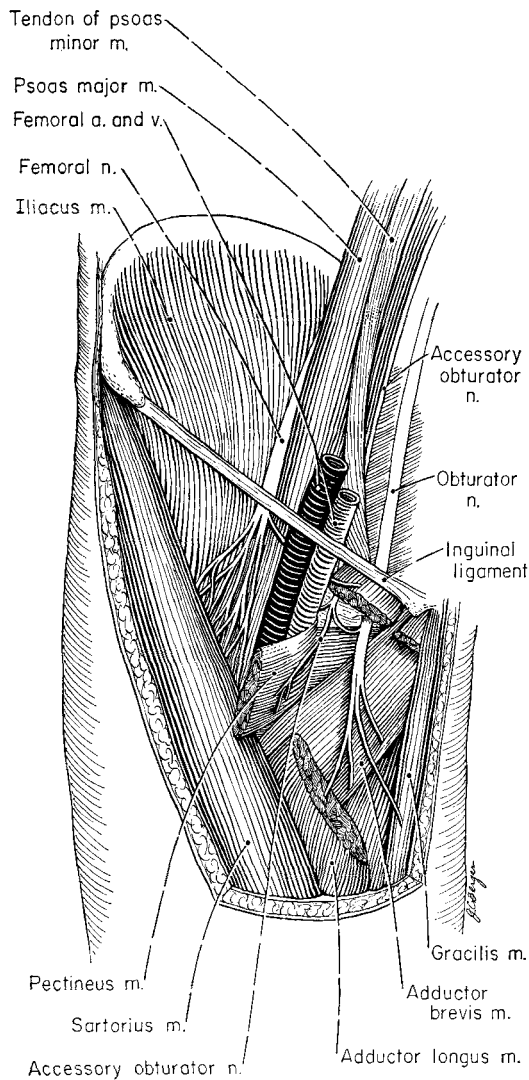


Figure 1

their sheath, ending in the ventrolateral aspect of the pectineus muscle.

The constant femoral supply of at least a part of pectineus and its occasional innervation through the accessory obturator nerve has raised questions concerning the derivation of the muscle. Eisler (1891) noted that the roots of the accessory nerve push out between those of the pre-axial obturator and the postaxial femoral nerves. At the same time he unequivocally classified the accessory nerve and the nerve to the pectineus as parts of the ventral division of the lumbar plexus. Bolk (1894) placed the pectineus muscle in the ventral division of thigh musculature, although he recognized the problem of the nerve supply. He suggested that there may be reason to consider the pectineal branch of the femoral as an adventitious grouping for two reasons; the unusual course of the nerve behind the great vessels, and the fact that the nerve is frequently independent and is almost never firmly connected with the femoral nerve. Contrarily, Paterson (1894) classified the pectineus among the dorsal muscles but admitted to uncertainty. He noted that the muscle is at the meeting place of the dorsal and ventral thigh masses and may contain fascicles which are more properly associated with the adductor group. He believed (1891) that there is sometimes a part of the muscle which belongs to a ventral stratum which is combined with the major dorsal part. Kohlbrugge (1897) noted that pectineus is a border muscle between the territories of the femoral and obturator nerves and receives branches of supply from both. Gegenbaur (1898) reported that there is among the urodeles a pubo-ischio-femoral muscle mass from which pectineus differentiates. Within this mass pectineus consists of two layers innervated by two nerves, and the third part constitutes the iliopsoas muscle. Leche ('00) in a systematic treatise on musculature showed that in many mammals there is separated from the obturator externus muscle a muscle which he called the obturator intermedius. He believed it probable in those forms in which the pectineus is supplied by the obturator nerve that this obturator intermedius has entered into the formation of the anlage of the pectineus. Merkel

('01) described the muscle as consisting normally of two layers.

In an embryological study of lower limb musculature in man Gräfenberg ('04) found in his older specimens (6 weeks) that iliopsoas, pectineus, and adductor longus differentiated from a single mass which was served by the femoral and obturator nerves and by a loop between them. He considered pectineus as the border muscle in this complex which was therefore apt to be innervated by the femoral nerve laterally and the obturator nerve medially. Elsewhere Gräfenberg stated that the pectineus muscle is to be counted with the adductor group on the basis of function even though it is more commonly supplied singly by the femoral nerve than by both femoral and obturator. Bardeen ('06) was unable to confirm Gräfenberg's observation of a single primordium served by both femoral and obturator nerves. In a 14-mm human embryo in which pectineus was distinct, he found it separated by a small interval from the iliopsoas muscle mass and more closely associated with the anlage of the adductor longus. Into pectineus could be traced a branch of the femoral nerve. Bardeen noted a mass closely associated with the anlage of the external obturator and pectineus muscles which he thought might be the primordium of that part of the pectineus supplied by the obturator nerve in many individuals. More recently, Howell ('36) has interpreted both the muscle and its nerve as belonging to the ventral division of the thigh. He assigned the pectineus muscle to the "adductor matrix," a group supplied by the obturator nerve. Howell stated: "it is true that it is always innervated at least partially by n. femoralis, but its nerve is the only twig of the latter group that is derived from the ventral part of the plexus, and it is probable that, due to fasciculation or some comparable factor, a change in the pathway of the axons to this muscle is in progress." These axons presumably should be included in the obturator nerve. An accessory obturator nerve is an additional complexity. Bolk (1894) suggested that this small nerve may have been separated from the obturator proper in the formation of the obturator foramen. Howell ('36) noted that the pubis develops first

as a process, subsequently hooking around the obturator nerve and joining the ischium so as to enclose this nerve in the obturator foramen. The pubis apparently also developed so as to isolate the accessory obturator nerve as it hooked around the obturator.

There appears to be no unanimity among comparative morphologists in interpreting the origin and position of the pectineus muscle. It is certainly a border muscle but is most commonly allocated to the adductor group of the thigh. Its principal nerve supply is from the femoral nerve by a branch which is somewhat separately fasciculated and reaches the muscle across the dorsum of the femoral sheath. The muscle is also innervated by the accessory obturator nerve in the 8.7% of cases in which the nerve occurs. There may be reason to consider that a dorsomedial obturator portion of the muscle has a phylogenetic separation from a ventrolateral femoral portion.

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