

## ORIGINAL RESEARCH—ANATOMY/PHYSIOLOGY

# Cutaneous Corpuscular Receptors of the Human Glans Clitoris: Descriptive Characteristics and Comparison with the Glans Penis

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### ABSTRACT

**Introduction.** The female genital sensory pathways that initiate sexual arousal reflexes begin with cutaneous corpuscular receptors in the glabrous genital skin, including those of the glans clitoris.

**Aim.** The aim of this study is to characterize the corpuscular receptors of the glans clitoris. In addition, we compared basic features with the receptors of the glans penis.

**Main Outcome Measure.** Number of stained receptors.

**Methods.** Five cadaveric vulvectomy specimens and four cadaveric penile specimens were used. They were serially sectioned and stained with hematoxylin and eosin. Selected blocks were stained with Masson's trichrome, and immunohistochemical staining was done with neuronal markers S-100 and neurofilament.

**Results.** Using the three stains, we identified an abundance of corpuscular receptors within the glans clitoris, as compared with the surrounding prepuce. These receptors were of varied arrangements, situated in the subepithelial tissues of the glans clitoris. They were indistinguishable from the receptors of the glans penis. The number of receptors per 100× high-powered field ranged from 1 to 14, whereas the receptor density in the glans penis ranged from 1 to 3. A second type of receptor, the Pacinian corpuscle, was identified within the suspensory ligament along the trunks of the dorsal nerve but not within the glans itself.

**Conclusions.** The glans clitoris is densely innervated with cutaneous corpuscular receptors, and these receptors are morphologically similar to the corpuscular receptors of the glans penis. The glans clitoris has greater variability in receptor density compared with the glans penis. **Shih C, Cold CJ, and Yang CC. Cutaneous corpuscular receptors of the human glans clitoris: Descriptive characteristics and comparison with the glans penis. J Sex Med 2013;10:1783–1789.**

**Keywords.** Female Genital Anatomy; Vulva; Clitoris; Corpuscular Receptors; Clitoral Innervation

### Introduction

Genital tactile stimulation is a crucial component of sexual arousal. Similar to its homologue, the penis, the clitoris has an important physiologic role as both a receptor and transformer of erotic tactile stimuli [1]. The female genital sensory pathways begin with a dense collection of nerve endings in the external genital

glabrous (nonhair bearing) skin, including that of the glans clitoris [2]. Terminal endings of nerve fibers in the skin are often categorized into two morphologic groups: free nerve endings and corpuscular receptors. These structures respond to and transform stimuli to initiate the sexual reflexes.

Corpuscular receptors are mechanoreceptors and have been recognized in the human glans penis since the mid-1800s [3,4]. More than a century later, Halata and Munger's [5] comprehensive ultrastructural study of penile nerve

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endings demonstrated that free nerve endings abounded in the human glans penis, along with specialized corpuscular receptors, including so-called genital end-bulbs [5].

The glans clitoridis is believed to share a comparable pattern of genital innervation with the glans penis [6]. Animal studies in monkeys [7], guinea pigs, and mice [8,9] have demonstrated the presence of corpuscular receptors in the clitoral skin; however, studies on the human clitoris have primarily focused on the identification of neuropeptides [10–14] within the erectile tissues. The structural sensory elements at the level of the glabrous genital skin—the determinants of clitoral sensibility—have yet to be defined.

Using immunohistochemical techniques and light microscopy, we conducted a preliminary neuroanatomical study to describe the cutaneous corpuscular receptors of the human glans clitoridis, comparing and contrasting when possible to those of the glans penis. Defining the basic characteristics of the cutaneous receptors is an important step in understanding how the glans clitoridis functions as a sensory organ transforming erotic stimuli and the role it plays in female sexual function.

## Methods

Five cadaveric female vulvectomy specimens and four cadaveric male penile specimens were available for this study. The ages of the cadavers were unknown, although the female specimens appeared to be from postmenopausal women. Tissue samples were embalmed in 40% ethanol and 20% glycerin. They were transferred later to 10% neutral buffered formalin for processing (formalin-fixed, paraffin-embedded tissue blocks).

All vulvectomy specimens were serially sectioned and submitted in separate cassette blocks. Because of its small surface area, the glans clitoridis was examined in a single section taken longitudinally, extending from the tip of the glans to the body of the clitoris. Serial sections were then stained with hematoxylin and eosin to examine general histologic features, and selected blocks were stained with Masson's trichrome. Immunohistochemical studies were done on select sections with antibodies raised against neuronal markers S-100 (Dako Polyclonal Rabbit Anti-S100, Dako North America, Inc., Carpinteria, CA, USA) and neurofilament (Thermo Fischer Monoclonal Mouse Anti-Neurofilament, Thermo Scientific, Fremont, CA, USA). The immunohistochemical staining was performed on the Leica Bond III

autostainer (Leica Bond III Autostainer, Leica Microsystems, Bannockburn, IL, USA).

The penile specimens were divided into four regions: the dorsal corona, the ventrum (including the reflection of the frenulum), the right lateral corona, and the left lateral corona. Serial sections were processed in the same manner as the vulvectomy specimens.

Corpuscular density was determined at 100× magnification and recorded per 100× high power field (HPF). Due to its larger surface area as compared with the glans clitoridis, each region of the glans penis was counted separately. As noted above, the glans clitoridis was sampled comprehensively in one section. Several 100× HPFs were counted in each specimen, and the average density of corpuscular receptors in each specimen was recorded. The ocular diameter of the 100× field was 1.55 mm.

## Results

### *Anatomic Differences Between the Glans Clitoridis and the Glans Penis*

To frame the subsequent comparison between the sensory corpuscular innervation of the glans penis and the glans clitoridis, it is important to clarify the general anatomical differences between the organs. Grossly, the glans clitoridis is the anterior superficial aspect of the clitoral unit, whose body (shaft) extends posteriorly from the glans, separating proximally into paired crura, which extend along the anterior aspect of each ischiopubic ramus. The wishbone-shaped clitoral unit has been described previously [15,16]. Microscopically, the glans clitoridis is a fibrovascular cap of nonerectile, specialized, sexually responsive, genital vascular tissue that is distinct from and superficial to the erectile tissues of the corpora cavernosa of the clitoral body (Figure 1), which is surrounded by the fibrous tunica albuginea. In contrast to the glans clitoridis, the glans penis is composed of erectile tissue of the corpus spongiosum. The dense connective tissue of the lamina propria, in the absence of a distinct tunica albuginea in the glans penis, blends with the smooth muscle-rich trabeculae of the erectile tissue.

### *Corpuscular Receptors of the Glans Clitoridis*

The somatic innervation of the glans clitoridis is mediated by the dorsal nerve of the clitoris (DNC), a branch of the pudendal nerve. The paired DNC travels distally along the dorsal aspect of the clitoral body at the 11 o'clock and 1 o'clock

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