

REVIEW

The Clitoris—An Appraisal of its Reproductive Function During the Fertile Years: Why Was It, and Still Is, Overlooked in Accounts of Female Sexual Arousal

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Stimulating the clitoris activates the brain to instigate changes in the female genital tract, namely, the enhancement of vaginal blood flow that increases vaginal luminal pO₂, vaginal transudate (lubrication) facilitating painless penile penetration and partial neutralization of the basal luminal acidic pH, vaginal tenting, and ballooning delaying sperm transport and allowing semen de-coagulation and capacitation (sperm activation) factors to act until arousal ends (often by orgasm induction). All these genital changes taken together are of major importance in facilitating the possibility of reproductive success (and thus gene propagation) no matter how or when the clitoris is stimulated—they reveal its overlooked reproductive function. Of course, also commensurate with these changes, is its activation of sexual pleasure. The clitoris thus has both procreative (reproductive) and recreative (pleasure) functions of equal importance. Clitoridectomy creates not only sexual disability but also a reproductive disability. *Clin. Anat.* 00:000–000, 2019. © 2019 Wiley Periodicals, Inc.

Key words: clitoris; sexual arousal; reproduction function; vaginal tenting; increased vaginal blood flow; vaginal lubrication; capacitation; evolution; reproductive fitness

INTRODUCTION

“To see what everyone else has seen and to think what no-one else has thought.” Albert Szent-Gyorgii, 1957, *Bioenergetics*, Academic Press, New York.

The new concept that the clitoris is involved in facilitating reproduction was reported briefly in Levin (2018). The present review examines and defends this activity (Table 1) in greater detail and presents supportive studies for the function. All of the physiological aspects of the activity have been empirically confirmed and none are implied interpretations.

The identification, anatomy, and function of the human clitoris have a long history. The early controversies over the organ have been described by O’Connell et al. (2005) while Blechner (2017) noted that “from ancient to the present day, the anatomy of the clitoris

has been discovered, repressed, forgotten, denied or shrunk and rediscovered many times.” Its first mention in the Western literature was probably by the French physician and anatomist Charles Estienne (1545) but he mistakenly thought that it had a urinary function. Its sexual recognition was claimed by Renaldo Colombo (1559) who described it as “the seat of woman’s delight” but others (viz: Gabriele Falloppio, Jan Swammerdam, Regnier de Graaf) challenged his discovery (Di Marino and Lepidi, 2014). Andreas Vesalius (Vesalius, 1564), a surgeon at Padua, argued that the clitoris was a useless part; an anomaly only found in hermaphrodites and did not exist in healthy women.

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TABLE 1. Physiological Changes Induced in the Vagina by Clitoral Stimulation that Facilitate Reproductive Fitness

Vaginal changes induced by clitoral stimulation	Reference
Increasing heart rate and blood pressure to enhance vaginal blood flow—and by decreasing vaginal vasomotion	Masters and Johnson (1966); Levin and Wylie (2008)
Increasing vaginal lubrication—augmentation by neurogenic transudation facilitating painless penile vaginal penetration	Masters and Johnson (1966); Levin (2003, 2017a, 2017b, 2017c)
Increasing vaginal pO ₂ —facilitating sperm motility and aerobic metabolism with increased energy production	Wagner and Levin (1978)
Partial neutralization of basal vaginal acidity	Masters and Johnson (1966); Wagner and Levin (1984)
Activating vaginal tenting and ballooning which delays sperm transport from the vagina	Masters and Johnson (1966); Levin (2002, 2005, 2012)
Facilitating their contact with capacitation factors	
Increasing vaginal temperature—enhancing male sexual arousal through penile temperature sensation (hedonic amplification)	Levin (2015)

While other authors/anatomists described the female genitalia (see Di Marino and Lepidi, 2014 for historical references) it was not until Georg Kobelt, a German anatomist, published in 1844 a book of detailed anatomical drawings based on his dissections of male and female genitalia that were accurate, and to a large extent, definitive. Despite his anatomical accuracy, Kobelt's studies and concepts (Kobelt, 1844; Kobelt, 1978) were ignored in England and the United States and numerous physicians claimed that the clitoris was a useless structure while some even argued that it should be surgically removed to cure particular female sexual behaviors and carried out such drastic treatment (Sheehan, 1981; Levin, 2014).

Despite numerous modern accounts that characterize the activation of human female sexual arousal by clitoral stimulation none appear to have referred to it possessing any involvement in a specific reproductive role (viz: Dickinson, 1949; Kinsey et al., 1953; Sherfey, 1966; Singer, 1973; Kaplan, 1974; Symons, 1979; Hrdy, 1981; Seveley, 1987; Gould, 1992; Gilbert, 1993; Leroy, 1993; Baker, 1996; Angier, 1999; Miller, 2001; Morris, 2004; Tuana, 2004; Lloyd, 2005; Kauth, 2006; Komisaruk et al., 2006; Martin, 2007; Waskul et al., 2007; Bancroft, 2009; Bizimana, 2009; Brody, 2010; Frith, 2015; Di Marino and Lepidi, 2014; Gray and Garcia, 2013; Guruge, 2015; Pauls, 2015; Mazloomdost and Pauls, 2015; Estupinyà, 2016; Pavličev and Wagner, 2016; Pfaus et al., 2016; Blechner, 2017; Jannini et al., 2018; Kennedy and Pavličev, 2018; Wikipedia, 2019) despite the fact that the same structures are involved in both the recreative and procreative functions (Levin, 2002). Nearly, all repeat the mantra that "the clitoris is the only human organ whose *sole function* (my italics) is the transmission of sexual pleasure" (Leroy, 1993). Even Masters and Johnson (1966, p. 56, 61), who were highly active promoters of the fundamental importance of the clitoris to women's sexuality, wrote that "while the literature contains innumerable discussions of the role of the clitoris in female sexuality, authoritative opinion has reached essential accord only in the view that the primary function of the organ is to stimulate female sexual

tensions." They did not suggest any indication of this having any specific physiological function in reproduction. Another account by an author that focuses solely on the orgasmic aspect of clitoral stimulation with a complete disregard of the reproductive aspects is that of Miller (2001). According to Miller's highly speculative theory, the clitoris evolved as an organ that allowed women to discriminate between their sexual partners, only becoming active to generate an orgasm during coitus when given the right stimulation. As a mechanism for female choice, Miller argued that clitoral orgasms would not be expected from every male attempt at copulation but only from those who attract the woman "by his body, mind, personality, attentiveness and fitness through the right stimulation." Because of this overwhelming fixation on clitoral-induced sexual pleasure, it is easy to think that this function is the only game in town! The question is—why have all the authors overlooked the specific role of the clitoris in reproduction? Those of antiquity can obviously be excused because the particular aspects of the female genital tract response to sexual arousal were not described at their time and others because the physiology of sperm handling in the genital tract was not fully characterized (viz, pre-capacitation and capacitation mechanisms to activate fertility in spermatozoa). For others, it may be an example of "functional fixatedness" or "thinking-as-usual" illustrating an impaired ability to reveal a new use for an object owing to its previous use in a different functionality. In a way this is not so unexpected, for to appreciate the reproductive role of the clitoris it is necessary to combine, among other aspects, the complex physiology of the release, pre-activation and activation (capacitation) of spermatozoa to become fertile (see Figure 1), the genital tract sexual arousal changes necessary to handle and process the seminal ejaculate in the female, the need of the female to restrict the number of sperm reaching the ovum to avoid polyspermy (more than one sperm entering the ovum, Wolf et al., 1984) and excess enzyme release from the sperm during the acrosome reaction from creating ovum degeneration both features causing reduced fertility; this involves being familiar with

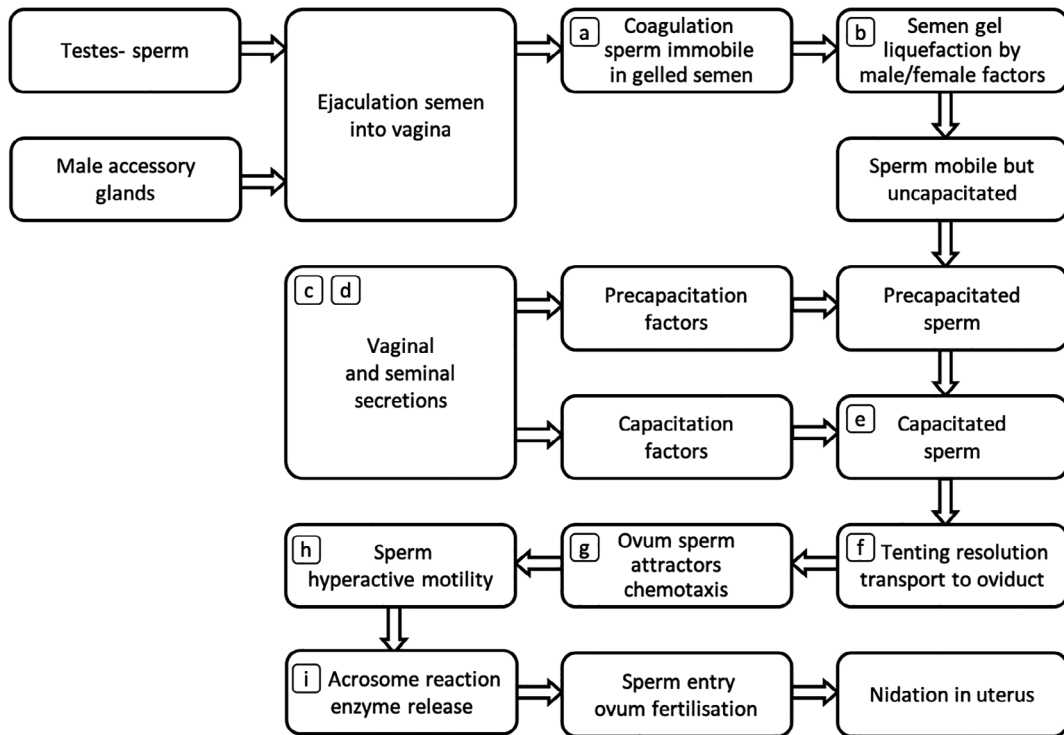


Fig. 1. The cascade of the major changes to semen and spermatozoa in the female genital tract. The alphabetical lower case letters in brackets in the left hand corner of the boxes are listed below with the relevant references for the specific process. (a) Hartman (1957). (b) Lilja and Lundwall (1992). (c) Fraser et al. (2003). (d) Fraser et al. (2006), Levin (2005), and Murdica et al., 2019. (e) Austin (1951), Austin and Bishop (1952), Bailey (2010), Cohen-Dayag et al. (1995). (f) Masters and Johnson (1966). (g) Eisenbach and Giojalas (2006), Bahat and Eisenbach (2006), and Kaupp et al. (2008). (h) Suarez and Pacey (2006), Suarez (2008). (i) Brucker and Lipford (1995), Nagae et al. (1986) and Okabe (2013).

both the reproductive physiology and the sexology literature (Levin, 2002, 2005, 2011a). Unfortunately, members of the two disciplines have little or no interdisciplinary co-operation, rarely meeting together and each having its own literature, conferences and societies and get research grants from different sources. This dichotomy is well illustrated by the numerous published models of human sexual responses none of which show their possible role(s)/influences in the reproductive process (Levin, 2017a). Bennett (1995) thought that the "clitoris can be radically outside the reproductive economy" a concept echoed by Nancy Tuana (2004) as "it is a pleasure seated from reproduction." Antagonistic attitudes toward a reproductive function are exemplified in an editorial comment where even the anatomist Helen O'Connell (2001) provocatively argued that to "attach a reproductive function to sexual arousal mechanisms is against sexual pleasure" and that "to find a reproductive explanation for a sexual phenomenon creates a lack of recognition of female sexual function as distinct from reproduction." More recently, Joanna Ryan (2019), a psychoanalytic psychotherapist, in her review of the book "The Anatomy of the Clitoris" by the psychoanalyst

Anne Zachary (2018, p 21) criticized the author because she had proposed (albeit without quoting any convincing physiological supporting evidence) that "the clitoris... is not purely for pleasure" and that "anatomical insights convey that the clitoris also support and is involved in the structures concerned with conception and child bearing." Ryan (2019) pontificated antipathetically that "we are once again at the scene of the potential for female sexual experience and pleasure being ultimately subsumed to the functions or purpose of heterosexual reproduction." Such comments not only fail to recognize the duality of sexual arousal mechanisms that commonly serve both procreation and recreation (Levin, 2002), but also imply that reproductive mechanisms and their study are somehow inferior to those generating sexual pleasure, unfortunate and meaningless value judgments.

A speculation about the possible reproductive precursor of clitoral function has been published by Pavličev and Wagner (2016). They suggested that the evolutionary precursor of women's orgasm was the activation of reflex ovulation. They proposed that "copulation-induced ovulation is triggered by clitoral

stimulation" and that "the clitoris is the main source of the orgasm-induced endocrine surge in all mammals, as it is in women." What they obviously overlooked in formulating their hypothesis is that clitoral stimulation activates, via the brain, a series of physiological changes (see Table 1) that precede the induction of orgasm/ovulation and that these changes prepare the human female genital tract for the possible entry of semen and its contained spermatozoa to ensure their conversion to their capacitated, fertile state. Which developed first from clitoral stimulation, the induction of sexual pleasure or the genital changes is a moot point, although they may well have developed simultaneously.

An interesting anatomical feature of the clitoris reported by Battaglia et al. (2008) is that its body volume increases during the peri-ovulatory phase of the menstrual cycle and remains so until day 20 (of a 27 day cycle). The organ thus becomes significantly larger and more prominent around the time of the highest probability of conception, a feature commensurate with its reproductive function.

THE CASCADE OF CHANGES THAT OCCUR TO SPERMATOZOA IN THE FEMALE GENITAL TRACT

It should be realized that the physiological changes brought about by clitoral stimulation in the female genital tract (Table 1) co-ordinate with the set of biochemical changes essential to activate the ejaculated, but immobile and un-capacitated spermatozoa to a motile, fertilizable state. This cascade of semen and spermatozoal changes is shown in the flow diagram of Figure 1.

THE CONFUSION AS TO WHAT FEMALE GENITAL STRUCTURES ARE STIMULATED DURING COITUS

It was erroneously proposed (Brody, 2010) that penile vaginal coitus (PVI) per se specifically stimulated only the vagina, and possibly the cervix, but not the clitoris while the erotic properties of the periurethral glans (Levin, 1991) and the labia minora (Masters and Johnson, 1966, p. 64) were ignored. The incorrect conclusion was further superseded when the greater complexity of the internal clitoral structure was characterized (see Levin, 2018 for full references). Experimental investigations showed that the internal structures of the clitoris would be stimulated via the anterior vaginal wall during physical intromission of the organ during penile thrusting (Buisson and Jannini, 2013). In fact, its presumed activation during the penile thrusting of coitus had previously been suggested by Ingelman-Sundberg (1997) who described its stimulation through the stretching of the anterior vaginal wall and its mediation by the ligamentous attachments to the base of the clitoris. Costa and Brody (2014) later had to acknowledge that "internal structures of the clitoris may have a role in sexual arousal before or during vaginal intercourse (PVI)" but tried to mitigate this grudging acceptance by adding "penile stimulation of the vagina is

likely to create qualitatively different arousal and orgasm compared to the stimulation focused on the clitoral glans." No definitive empirical evidence for their "qualitatively different orgasm" concept has been forthcoming. Paradoxically, the coital activity that Brody et al., (2013) promote as the ideal for achieving PVI-induced orgasm is that of Coital Alignment Technique (CAT). In the most detailed exposition of CAT (Levin, 2018), the sexual arousal activated by the shallow placed penis in the female introitus has been shown to be categorized by its superficial stimulation of the glans clitoris, the periurethral glans and the labia minora and not of any deeper vaginal structures. Thus, even PVI alone will cause periurethral and clitoral structures to be stimulated, which will activate sexual arousal in the brain and thus initiate the reproduction-involved changes in genital arousal (see Table 1). It has never been revealed why this clitoral stimulation does not cause the "noxious outcomes" that clitoral stimulation (digitally or vibrationally) is claimed to create even when occurring during coitus. In this context, neither Prause et al., (2016) nor Therrien and Brotto (2016) found negative mental health in women who used clitoral stimulation.

A study by Shafik et al. (2005) proposed that vaginal tenting was a clitoral-activated reflex which they named the "clitorouterine reflex." They concluded this from their investigations using uterine electrical recordings in healthy female volunteers before and during clitoral stimulation. Their evidence for this was that the uterine electrical activity was inhibited by clitoral stimulation but this inhibition did not occur when the uterus and/or the clitoris were anesthetized. Unfortunately, the authors erroneously thought that this tenting reflex would facilitate sperm transport when it actually does the exact opposite, by delaying it! In fact, they are not the only authors (Gallup et al., 2018; King et al., 2016) who still question or ignore that vaginal tenting occurs when a woman becomes sexually excited and that this will delay the transport of spermatozoa until the arousal subsides. This rejection occurs despite a number of published studies that have incontestably confirmed the occurrence of vaginal tenting using direct observation and filming, genital imaging, and electrical recording (see Levin, 2011a, 2017b for the references). Moreover, the procedure used by King et al. (2016) to examine the concept of the uptake of spermatozoa by the uterine/cervix complex during orgasm has been shown to have flaws (Levin, 2017b, 2017c) that expose the inadequacy of the experimental protocol so that their conclusion of orgasmic-induced sperm upsuck during coitus cannot be confirmed or concluded by the results of the study.

THE CLAIMED NEURAL MECHANISMS FOR ACTIVATING THE NEGATIVE HEALTH ATTRIBUTIONS FROM CLITORAL STIMULATION

Despite numerous publications describing "noxious outcomes" associated with the stimulation of the clitoris alone or even during penile vaginal intercourse

(Brody, 2010), the outstanding question is the neural mechanism(s) by which these claimed noxious physiological, psychological (mental) and social effects could arise from the different genital stimulations. The initial proposal was that they most likely could occur because the anatomical structures had separate sensory innervations (clitoris = pudendal nerve, vagina = pelvic nerve and cervix = hypogastric, pelvic and possibly the vagus nerves). Brain imaging during selective sexual arousal from clitoris, vagina, and cervix has been employed in an effort to provide support for the claimed different effects of clitoral versus vaginal stimulation. However, though extremely useful, brain imaging is not the “silver bullet” to understand the mechanism of neural sexual arousal. While it identifies the locations of activation and inhibition of brain sites, it does not characterize the operation of the neural processes at these sites or their connections. Published neuroimaging studies of sexual arousal simply describe the brain areas that are either active, inhibited or remain quiescent by the sexual stimuli, imaging can identify the location but not the operation of psychological processes. What is also needed is how they are functionally connected in the whole brain (Sporns, 2013). Furthermore, another problem with trying to use brain imaging during sexual arousal from specific organ stimulations is that there is no consensus as to which sites in the brain are activated, inhibited or remain unresponsive. Georgiadis (2012) obtains quite different results than those of Komisaruk and Whipple (2005) in relation to whether the frontal and temporal critical regions become activated (Komisaruk and Whipple, 2005) using fMRI or deactivated (Georgiadis, 2012) using PET scanning; opinions are split and it is not possible at present to make a definitive decision as to which description is the most accurate (Jannini et al., 2018). Another problem is that the brain site of representation of the clitoris is different in the studies of brain imaging by Georgiadis et al. (2006) with that of Komisaruk et al. (2011). Despite these difficulties, the latter group used brain imaging in just 11 female volunteers who self-stimulated separately their clitoris, vagina, and cervix. The fMRI scans of their sensory cortices during this induced sexual activity apparently indicated that each separate organ stimulation had a punctate area representation clustered in the medial cortex (medial paracentral lobule) of the brain with, however, some overlapping. This finding was assumed as providing evidence for the concept that diverse health effects could arise from these punctate areas. Critical examination, however, reveals experimental shortcomings that make this conclusion more than problematic. These have been described previously in Levin (2012, 2014, 2015) namely, in brief, (1) the vaginal stimuli used rods (passive dildos) and/or digital rhythmic clitoral tapping that are not ecologically valid, the use of the former was in fact actually previously criticized by Costa and Brody (2011) when used by individuals and in other studies, (2) each structure was stimulated separately in isolation of the others. The punctate sites appear to be a spurious finding created because the study used non-ecological stimuli acting independently on separate genital structures, features that do not occur during the natural coital scenario where multiple areas of the brain become

activated (Levin, 2011b). There is, however, another unusual and somewhat complex brain sexual arousal study using blood oxygen level dependent (BOLD) imaging by Bianchi-Demicheli and Ortigue (2009) that on first impressions could be interpreted to support the concept of the so-called “noxious” activity arising from different brain areas. In this study, 29 university students were exposed to subliminal images of their loved partner’s name that appeared on screen while they were performing a lexical decision task designed to keep their attention focused on the monitor. Each subject was specifically asked questions about the memory of the different types of orgasmic experiences (clitoral orgasms from partner stimulation only versus orgasms from PVI) and scores from sexuality questionnaires were correlated with specific brain areas. The scores of orgasm quality obtained by clitoral stimulation linked with brain responses in the left insula only while those obtained from PVI were linked not only with the left insula but also with the right superior temporal gyrus, thalamus, and right prefrontal gyrus. At first, this suggests that clitoral stimulation and PVI are represented by different neural networks in the female brain and that these could, perhaps, create different behavioral patterns. However, a number of unproven assumptions have to be made to infer this possibility. Firstly, and the most important, is that simply creating a map of areas of the brain that respond to the brief subliminal stimulation of the name of the loved and desired partner does not necessarily indicate that these areas are related to sexual activity per se but simply to memory aspects of the loved and desired person. Second, is the use of the Female Sexual Functioning Index (FSFI), a self-report questionnaire initially devised specifically for screening for the current detection of female sexual dysfunction rather than sexual function per se by assessing six aspects of sexual function: desire, arousal, lubrication, orgasm, satisfaction and pain (Rosen et al., 2000). The context of using it to correlate with specific, normal sexual memories of clitoral and PVI pleasure is a highly novel application of the questionnaire to say the least. The FSFI itself has been the subject of a number of criticisms; Forbes et al. (2014) warned about taking care with its use as an appropriate measure in research while Neijenhuis et al. (2019) found conflicting and lack of evidence for some of the measurement properties and that it needed more research on structural validity and measurement error. Other difficulties are that it does not measure sexual experience, knowledge, attitudes or interpersonal functioning, all possible factors involved in sexual memories. The FSFI, despite its extensive use in clinical assessments of sexual dysfunction, is clearly yet to be examined critically as a valid measure of sexual memories as employed in the Bianchi-Demicheli and Ortigue brain imaging study. Interestingly, in the context of employing subliminal stimulation as a sexual stimulus for diagnosing paraphilic disorders, Kuptsova et al. (2019) concluded that changes in vegetative processes (namely in their case polygraph testing) did not allow the importance of the stimuli presented to be judged.

The neural input from the highly sensitive clitoris actually causes widespread brain activation (an “arousal matrix”) before orgasm (Komisaruk et al., 2011; Wise

et al., 2017) rather than just its punctate representation as described above. In fact, sexual activation involves many generic areas of the brain including those for arousal, reward, memory, cognition, self-referential thinking and social behavior (Georgiadis, 2012; Ruesink and Georgiadis, 2017; Jannini et al., 2018). As Komisaruk (2012) has admitted "all major brain systems evidently contribute to women's orgasms," but before orgasm occurs, the initiation of the brain-activated combination of genital changes takes place to ensure the best genital tract preparation for maximizing reproductive fitness (see Table 1). Because these changes are independent of either the stage of the menstrual cycle or the concealed ovulation of the human female (Burley, 1979), it ensures that the female's genital tract is always prepared for sperm reception and its handling ensuring the greatest potential for possible fertilization. This clitoral function makes Brody's (2010) emotive concept that evolution "rewards" those females that have PVI alone but "punishes" those who use clitoral stimulation as wholly untenable.

IS THE PLEASURE OF SEXUAL AROUSAL PER SE THE REWARD FOR CLITORAL STIMULATION?

Humans enjoy two distinct kinds of sexual pleasure, namely that created by sexual foreplay (usually by stimulation of genitals and erogenous areas) and the pleasure of orgasm. The latter is ecstatic but short-lived lasting but seconds while the former can be extended and prolonged and in some cases controlled to prevent its ending by orgasms, namely, Tantra sexual activities (Lousada and Angel, 2011). A general assumption is that the reward from clitoral stimulation for most women is its relatively easy activation of arousal to orgasm. Nicole Prause (2011), however, posed the highly controversial question "Is the female orgasm rewarding?" She noted that in brain physiology reward is usually accompanied by increases in brain dopamine. Sampling cerebrospinal fluid in males during arousal to orgasm, however, yielded negative findings in regard to dopamine concentrations (Kruger et al., 2006) although a similar assessment has not been undertaken in women. However, the fact that prolactin secretion is increased by the female orgasm suggests that there is a down regulation of dopamine as the hormone decreases hypothalamic dopamine (Bianchi-Demicheli and Ortigue, 2007). Sexual arousal per se also activates areas consistent with reward (Bianchi-Demicheli and Ortigue, 2009; Kringlebach and Berridge, 2009). The relation of brain dopamine to pleasure/reward however has become complex (Bressan and Crippa, 2005). According to Berridge and Kringlebach (2015) dopamine specifically increases motivation components of reward producing "wanting" without causing "liking." Various studies have suggested that sexual reward per se is mediated by opioids in both males and females in the medial preoptic area (Parades, 2014).

In a later follow-up to her first article, Prause (2018) further developed her concept that "sexual incentive motivation" emerges from a sensitive internal sexual system encountering external "incentive" stimuli." These may be primary (such as genital touching) or secondary (such as sexual imagery). In her analysis, the high sexual arousal appears to evoke a unique physiological state actually ended by the orgasm. A state shift occurs before orgasm when EEG is recorded indicating a shift in cognitive control and meditative entrainment (Prause, 2017). Interestingly, in totally different types of investigation, a number have reported that while women enjoy orgasms as much as men they appreciate coitus and its pleasures but pay lower regard to orgasm per se (Fisher, 1973; Hite, 1976; Clifford, 1978). According to an internet survey (Good in bed survey, Report Number 3, 2016), women care less about having an orgasm during every sexual act than men (important to 91% men and only 20% women). Such findings marry well with the reward function of sexual arousal from clitoral stimulation not only being the reward to the brain but also the genital arousal created ensuring that the genital tract was primed and prepared to receive and process the ejaculate. It is interesting in the context of the above discussion to note that clitoral stimulation is said to be rewarding even for female rats (Parada et al., 2010).

CLITORIDECTOMY AND CLITORAL SURGERY

The control of female sexual pleasure has been undertaken in a number of countries and cultures employing a variety of clitoridectomies. Levin (2018) described five different manifestations, in brief these were: -

- i. Psychological clitoridectomy—avoiding its stimulation to create a vestigeal organ,
- ii. Symbolic clitoridectomy—societies silence during adolescence about its pleasures,
- iii. Freudian clitoridectomy—clitoral investment creating a barrier to adult genitality,
- iv. Ritual clitoridectomy—clitoral cutting to reduce desire for non-marital sex,
- v. Medical clitoridectomy—non-therapeutic surgery to cure female mental conditions.

The last two involve the actual physical removal of the external parts of the clitoris, a cultural/social/religious ritual still practiced worldwide but concentrated in a number of mainly Middle Eastern and African countries on young girls, usually before puberty and without their consent or anesthesia. In recent years, because of migration and the movements of refugee populations in Europe and America, the practice among the females from such countries practicing genital cutting is apparent. The number of females who have undergone this cutting is estimated worldwide as 200 million. Repairing such clitoral cutting by clitoral reconstruction can be undertaken but the limited published literature indicates the scarcity of evidence on the safety, efficacy, and long-term follow-up

of the procedure(s) (Berg et al., 2017). Different procedures have to be employed for the various types of genital cutting that the female has experienced (Abdulcadir et al., 2015a, 2015b). In the review by Abdulcadir et al., (2015a) of a series of clitoral reconstructions (n = 3,725 subjects), a visible clitoris was apparent in 77% of those treated with most reporting improvements in sexual life 1–12 months after surgery but up to 22% experienced a decrease in sexuality related outcomes after the reconstruction.

There are unrealized consequences created by female genital cutting. Apologists compare the unequal legality of male circumcision with the illegality of female genital cutting (Shahvisi and Earp, 2019) but in physiological terms, the comparison of the two conditions is not equivalent. The latter creates not only possible sexual disabilities but also a reproductive disability, as described in the present article, male circumcision creates neither, although some males might regret the involuntary loss of their foreskin. Moreover, neither those that promote and support clitoridectomy nor those various organizations and international agencies that condemn it have realized that a consequence of the removal of the clitoris, apart from loss of its sexual pleasure function, is the loss to the individual of the activation of the physiological mechanisms that evolution has bestowed in our female to prime her genital tract to receiving and handle the ejaculated sperm in preparation for ovum fertilization. This creates not only a sexual disability but also a fortuitous reproductive disability. While there are some self-reports from clitoridectomised women who are still able to have sexual arousal to orgasm from coital penile thrusting (Catania et al., 2007) it is an outcome that is not inconsistent with the fact that their genital tract still cannot be pre-activated by clitoral stimulation before coitus to prepare for the ejaculate, their sexual arousal to activate genital changes only occurs later during penile thrusting.

Women who have common aberrations of their clitoral structure, such as their clitoral frenulum fusing with the labia, can report low sexual desire, pain, and difficulty in clitoral stimulation. It has been recently claimed that new clitoral surgery (clitoral frenuloreduction), admittedly in only three cases, improves their sexual activity, quality of life, self-assessed body image and sexual intimate function (Ostrzenski, 2019). Confirmation of the outcomes of the new surgical interventions needs to be undertaken by others in a greater number of patients.

FINAL COMMENTS

Freud (1905) stated that the function of the clitoris was “namely, of transmitting the excitation of the adjacent female sexual parts, just as—to use a simile—pine shavings can be kindled in order to get a log of harder wood on fire.” His main bias against the clitoris was because it facilitated sexual arousal far too easily in the early formative female years and that for so-called sexual maturity or full femininity to occur it had to be replaced by penile-vaginal dominated sexual arousal, namely, “The elimination of clitoral sexuality

is a necessary precondition for the development of femininity.” Remarkably, similar concepts are still promoted by a few contemporary neo-Freudians whose simplistic concept of women’s orgasmic sexuality is that it has but three stages of development, namely, clitoral orgasm is best an intermediate state between global anorgasmia and being fully vaginally orgasmic (Brody, 2007). An even more draconian claim by Brody (2010) is that using clitoral stimulation for sexual arousal, because it avoids the possible gene-propagating features of PVI, is “punished” by evolution resulting in “noxious consequences” (see Levin, 2014, 2018 for full discussion). This is a misrepresentation of evolution as a “judging mechanism,” as Kauth (2006) pointed out “Nature is not moral and takes no position on what ‘ought’ to be.” Costa and Brody (2014) speculated further that “vaginal orgasm evolved to promote PVI and consequent gene transmission in the situations of better fitness potential” but they completely overlooked the pre-orgasmic “better fitness potential” created in the female reproductive tract for facilitating sperm fertilizing potential induced by clitoral stimulation per se despite the fact that all the changes were well documented in the current literature.

In relation to Freud (1915), during the time that he practiced, the detailed physiological responses of the female genital tract to sexual arousal were not yet identified and described. It would also be some 36 years later before the details of sperm capacitation, independently discovered by Austin (1951) and Chang (1951), the process essential to their becoming fertile, and some 60 years later when Masters and Johnson (1966) described the changes in the female genital tract activated during sexual arousal. As these are now current and scientifically accepted, Freud’s proposal can be reassessed in light of these essential reproductive mechanisms. Namely, the reproductive task of the clitoris is to activate the brain to induce the combination of changes needed in the female genital tract to ensure with pleasure that if, in any ensuing following sexual scenario, coitus with semen ejaculation occurs into the vagina, then the best possible conditions are created for it to achieve reproductive success and thus maintain reproductive fitness. In terms that evolutionists employ, this reproductive function of the clitoris is its “proximate” function with regards to facilitating “ultimate” reproductive success in the female’s fertile years. While challenging major belief and values may prove to be difficult for some, the reappraisal of the functions of the clitoris as both reproductive as well as recreative are of equal importance is clearly now unavoidable.

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