Review article

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SMOOTH MUSCLE TISSUE OF THE NIPPLE-AREOLA COMPLEX

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The center of the breast integument is characterized by the roundish, glabrous (hairless) musculocutaneous specialization, nipple-areola complex, enriched with the integumentary class of smooth muscle tissue, which bundles are intimately intermingled with fibro-elastic connective tissue of the reticular dermis, with the openings of the distal, ending parts of excretory mammary gland ductal system, situated at the tip of the nipple. Inside this specific breast skin complex composed of two anatomically recognizable regions, muscle tissue is continuous, extending through the areola and nipple, nevertheless, functioning as one anatomic unit. Although present in both genders, in female physiology during the reproductive part of life, it is significantly more developed, and beside sexual arousal reaction, the major function of this structure is transitory contractile activity as essential part of physiological mechanisms necessary for regulated milk releasing during the period of breastfeeding. Nevertheless, analyzed in details and well defined from 19th century, latter, the topic of the nipple-areola complex muscular system in usual textbooks of anatomy and histology conceived unjustifiably a prejudice of marginality. Understanding the necessity for didactical recapitulation and systematization of data about the musculature of the complex and its associated structures, we reviewed the available literature, especially sources which were important for the theme and less often noticed in contemporary reviews.

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Key words: *areola, nipple, smooth muscle tissue, Sappey, Meyerholtz*

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Introduction

The center of the breast integument is characterized by roundish glabrous (hairless) skin specialization, nipple-areola complex, musculocutaneous specialization whose fibro-elastic connective tissue of reticular dermis is enriched with abundant smooth muscle bundles, and in its center, at the tip of the nipple, are situated openings of the distal, ending parts of excretory mammary gland ductal system (1-6). Although present in both genders, in female physiology, during the reproductive part of life, the major function of this structure is transitory contractile activity as essential part of physiological mechanisms necessary for regulated milk releasing during period of breastfeeding (5, 7-9). Nevertheless, composed of two anatomically recognizable regions, having specific characteristics (nipple and areola), muscle of the complex is continuous, extending through areola and nipple, functioning as one anatomic unit (10). The topic of the nipple-areola complex muscular system is somehow neglected, or suffered from simplifications or fragmentations, and it seems that is better elaborated in older, however often less available sources, so we understand that a review of the available literature should be needed for the purpose of recapitulation and systematization of data about the musculature of the complex and its associated structures.

In the nipple-areola complex, anatomically two major constituents could be recognized:

a) outer, peripheral, roundish, discoid, flattened area – areola (*areola mammae*) (Figure 1 – A) and

b) centrally positioned, elevated, conically shaped, nipple (*papilla mammae*, breast papilla, *mammilla*, mammary papilla, teat) (Figure 1 – N).

Well pigmented, hairless integument of the nipple-areola complex, from the limbus (Figure 1 – L) of areola, where abruptly transitions into the thin hirsute skin of the breast periphery (Figure 1 – obs)

extends toward the openings (Figure 1 – pl) of the ending parts of mammary glands ductal system (Figure 1 – dp), situated at the tip of the nipple. Major, and peripheral part of the complex, areola (Figure 1 – A), is delimited by shallow papillary furrow (Figure 1 – pf) from centrally positioned, nipple (Figure 1 – N). The average areola measures 15 to 60 mm in diameter (5, 11), while the nipple has a range of dimensions, on average 10 to 12 mm in width, and 9 to 10 mm in height, on whose tip there are observable 5-12 openings of the excretory mammary gland ducts (1-6, 11).

Histologically, it is possible to recognize two major structural components of the nipple-areola complex:

1) glabrous skin, with reticular dermis enriched with smooth muscle tissue bundles, and

2) terminal parts of excretory mammary gland ducts, which are opening at the tip of nipple. The skin of the whole complex is composed of epidermis, papillary dermis, and reticular dermis. Dermis of the nipple and areola skin is rich in fibroelastic connective tissue, and its reticular part is enriched with intermingled bundles of smooth muscle tissue. Skin of the areola is also characteristic by specific skin adnexa, Montgomery glands; and the nipple by sebaceous glands of its tip, associated with openings of mammary gland ductal system (1-6, 11). Remaining part of breast integument is represented by thin hirsute skin extending from outer areola limit – limbus of areola (Figure 1 – L), covering the rest of the breast, being continued with skin of thorax at the breast periphery (Figure 1 – obs). The structure of this unspecific skin resembles mostly to the skin of other parts of thorax integument; it is less pigmented than the skin of the areola-mammilla complex, it has hair follicles of vellus type, and hypodermis below, extending toward outer leaf of superficial fascia (1-3, 8, 12-15).

The epidermis (Figure 1 – e) of the nipple and areola have well developed ridges (more pronounced than in the rest of the breast skin), which are interdigitated with large and numerous dermal papillae of the papillary dermis (Figure 1 – dp). This jagged epidemo-dermal junction is considered as morphological adaption to the mechanical demands, present during possible breastfeeding (1, 3, 6, 7, 11, 16). Melanin pigmentation of epidermis is developing after menarche, in nulliparous Caucasian woman is of pinkish nuance, however in pregnant woman, during second month of pregnancy, this complex enlarges (specially areola) and develops brownish, almost black pigmentation, and remains partially maintained lifelong (5, 7, 8, 17-19).

Specific characteristics of the areolar part of the integument

The skin of the areola is characterized by small, papular, nodular structures, Morgagni`s tubercles (Figure 1 – Mt) (sometimes designated as Montgomery`s tubercles) (1, 18). These Morgagni`s tubercles, closer to, and around nipple base have random distribution, and on areolar periphery, are distributed in form of regular circle, parallel to inner side of limbus. Morgagni`s tubercles contain Montgomery`s glands (Figure 1 – Mg), considered as accessory areolar glands (1, 6). Montgomery`s glands are large modified sebaceous glands, developed in range from one alveolus to multilobular racemose glands (Figure 1 – asg), with their own (in 97% of cases), associated, miniature, branched, lactiferous duct (Figure 1 – ald), ending blindly in sub-areolar region (11, 20, 21). Associated sebaceous glands are positioned highly, and their sebaceous ducts are separately opening at the tip of Morgagni`s tubercles or are tributaries to Montgomery`s gland lactiferous duct, just before fusion of its epithelium with epidermis (11, 21). Hair roots (Figure 1 – h) may be the integral part of peripherally positioned Morgagni`s tubercles, near to limbus of the areola. If present, hair follicles, are individualy developped and active, and from them grow hair shafts, vellus or even terminal (8, 22). Lactiferous duct of Montgomery`s gland (Figure 1 – ald) appears to be a miniature of the major mammary system, and may develop fully functional lobules of the mammary gland. These mammary ducts are lined with two layers of cuboidal to columnar cells (11, 21). During lactation, secretions of these glands of areola are involved in lubrication of the areola and nipple skin, reducing irritation during breastfeeding. These glands may produce small quantities of milk, however mostly producing natural substance which has emollient and antiseptic properties. It is believed that the areolar glands may have a role in favorable beginning of breastfeeding and establishing the psychological bond between child and mother (16, 23, 24).

Specific characteristics of the nipple part of the integument

The surface of the nipple tip is coblestone shaped, and criss-crossed by shallow sulci, in whose bottoms there are observable five to dozen openings (*pori lactiferi*, lactiferous porus, Figure 1 – pl) (8, 11, 25) of the most peripheral (ending) portions of the mammary gland excretory system (papillary ducts, *ductus papillares*, Figure 1 – pd) (1, 14, 23). Just before its opening, the papillary duct (Figure 1 – pl) becomes funnel shaped, the part known as infundibulum (Figure 1 – inf), covered with stratified squamous keratinized epithelium, which is continued peripherally with the epidermis of the nipple tip, at the level of the duct oppening (3, 5, 18). Inside the dermis, in the close neighborhood of these infundibula, characteristic, large sebaceous glands of the nipple tip are present (Figure 1 – nsg). The excretory ducts of these sebaceous glands, covered by epidermis, open mostly separately onto the tip of the nipple, or less often into the ending part of the papillary ducts (1, 14). These sebaceous glands are the proof of the mammary gland development phylogenetic association with mechanisms observable during the development of "pilar complex", apo-pilosebaceous (or more specific mammolobular-pilosebacous) units (24). The eccrine sudoriparous glands are rarely, or not present in the skin of the areola and nipples (8, 22).

Often, in the literature sources, the most distal mammary ducts, present inside nipples, for

sake of simplifying explanation, are equilibrated with the lactiferous ducts. However, it is necessary to elucidate that these ducts, by their location, morphology and function, differ significantly from the lactiferous ducts. Namely, these peripheral, ending parts of the mammary gland ductal system are elsewhere known as papillary ducts (*ductus papillares*) (8), and are present only in the nipples. Two or few of them may be merged just before their openings (*pori lactiferi*) at the nipple tip, and toward the base of the nipple, may be continued as single, or arborized in few ductal structures (11, 26). Below the plane of the areola, each of these ducts is afterward continued with a single lactiferous duct (Figure 1 – mld), main draining ductal structure of one lobus of milk gland. At this plane, each lactiferous duct is widened (2-4.5 mm) into cone shaped lactiferous sinus (ampulla) (Figure 1 – ls) (3, 6). The lactiferous sinuses (ampullae) are predestined to function as temporary milk containers during a breastfeeding, however by some authors disputed as the structural element (3, 27). The major difference between papillary and lactiferous ducts is that former are lined by stratified squamous non-keratinized epithelium, and the ending with one funnel shaped infundibulum (Figure 1 – inf) (3), is covered by epidermis (1, 6, 23), and on the contrary, the lactiferous ducts are lined with two-stratified columnar epithelium. The smooth transition from lactiferous ducts toward papillary ducts epithelium is provided by the presence of stratified cuboidal in proximal parts, and stratified squamous non-keratinized, in lactiferous sinuses distal parts (28).

In available literature, one could encounter a versatility of the reported number of mammary glands excretory ducts, integral part of the nipples interior. The recorded numbers of ductal structures present inside the nipple goes from lesser 7 to 12 (21, 29), intermediate 15 to 25 (1, 3, 11, 12, 30) to higher values 27 to 48 (12, 26, 28). Additionally, mentioned versatility is combined with the significantly lesser number of their openings at the tip of the nipple (*pori lactiferi*), differently recorded, 5-10 (8, 11) or 7-12 (25). It is assumed that this ambiguity is based on two major factors:

1) limitations of different research methods applied (canaliculation, casting, histology, radiologic methods) (12, 25), and

2) on the individual variability and complexity of the anastomosing patterns between these ductal structures present inside the nipple (3, 6, 8, 12, 14).

Nevertheless, it is much more important to highlight that all of these ducts show tendency of quasi longitudinal position through the length of the medial, axial zone of the nipple, with three different patterns of their extension (straight, convergent, divergent) (31). Finally, this loose "bundle" of ducts, enters, extends longitudinally inside muscular "cylindric box" of the nipple (will be explained later in detail), and exits from it, finalizing with ductal openings at the tip of the nipple.

Mentioned parts of the excretory ductal system, lactiferous ducts, lactiferous sinuses, and papillary ducts, outside their epithelial lining, possess their own lamina propria (5), composed of fibro-elastic connective tissue (5, 32), and do not have own muscular tunic (33, 34). Ducts of nipple (altogether with their lamina propria), are crenulated structures, approximately 0.5 mm in diameter (12, 28, 30). The lamina propria of these ductal structures is composed of fibro-elastic tissue, in females in reproductive part of life, rich in numerous, coarse, mostly longitudinally oriented elastic fibers (6, 11, 14, 19, 32).

General organization of the nipple-areola complex smooth muscle tissue

Areolar-nipple muscle belongs to class of integumentary smooth muscle tissue (35), which bundles are intimately intermingled with bundles of fibro-elastic tissue of reticular dermis skin of the complex (5, 7-9). The smooth muscle cells may lie in bundles or singly and establish close connection with connective tissue bundles. Connective tissue of the areola and nipple is abundant in elastic fibers, with individual variations (14). Contractions of the smooth muscle cells are transferred to the closest reticular fibers, and then by elastic and collagen fibers of reticular dermis toward papillary dermis of regional skin. The presence of elastic tissue fibers associated with the smooth muscle cells is evidenced in some bundles up to 25% of the cross-sections (6, 14, 36). Besides individual variability, generally elastic fibers are at the height of their development and functionality during the reproductive phase of female life, before are less present, and after menopause degenerate (6). They are the most abundant inside the papillary dermis at the tip of the nipples, where many bundles spray out into extremely delicate fibers which advance and terminate in the vicinity of the basal epidermal stratum, sometimes almost completely fill the corial papillae. Elastic fibers are less present on the lateral sides of the nipples, and in the areola fewer still (6, 14, 37). In two places, namely at the papillary furrow (groove, Figure 1 – pf) and at the tip of the nipple, the musculature enters into a more intimate relationship with the skin (33, 34).

The muscle of the nipple-areola complex extends approximately from the outer border of the complex, the limbus of the areola, and under the base of the nipple continually extending into it, as the conically (dome) shaped muscle part of the complex. Symbolically, it could be said, that the nipple and areola together form an elastic, muscular hollow body in relation to the skin, as Dabelow (19) cites Nagel (38), which could be compared to the shape of a wide-brimmed hat. Marcacci (10) explained, that it is possible to distinguish two faces of the nipple-areola muscle: an upper or cutaneous (toward papillary dermis of integument), and an inferior or glandular (toward mammary gland). The cutaneous surface, follows as the flat structure the superficial parts of the areolar skin, and the other conical, elevated, which follows the structure of the nipple skin including the tip part of it. Here only should be added, that previously mentioned glandular face of the muscle, in areolar portion, is turned toward the mammary gland, and the glandular face of the nipple portion of the muscle, generally facing something which could be considered as the

extension of the mammary gland, the connective tissue of the axial (middle) zone, in which are aggregated and embedded the nipple papillary ducts.

In the nipple-areola complex, bundles of smooth muscle tissue have largely "circular", and to lesser extent radial, orientation inside the reticular dermis, forming planes parallel to the surfaces of the nipple and areolar skin (5, 7-9). It is necessary to highlight that areolar-nipple muscle, in both its parts is dominantly composed of circularly oriented smooth bundles, which could be observed in histologic sections, organized in several layers (33). However, rather than strictly circular, the orientation of smooth muscle bundles is tangential, helicoidal, antiparallel, criss-crossed, and furthermore organized in several physically continuous layers, building tri-dimensional muscular meshwork (19, 38). In explanation of multilayered tri-dimensional meshwork organization of "circular" parts of the nipple areola muscle perfectly fits the description of regional smooth muscle cells morphology given by Gairns et al. (36). Besides the common spindle shaped, they also described the smooth muscle cells of versatile morphology; as a larger, and a very branched, which varied from spindle forms with small spurs, through Y shapes and star shapes, to very irregular forms, showing overlapping, criss-crossing cells. Exactly the branched smooth muscle cell types would be necessary for the formation of complex, tri-dimensional meshwork muscular mass of the nipple and areola.

Specific morphology of areola part of the muscle

Rieffel (39) describes the areola part of the muscle as flattened, white-greyish, continuous layer, with average muscle thickness of 2 mm, and sectioned antero-posteriorly has a triangular profile, or as rhomboid (33), which narrows and extends with its tip to the areola limbus, and its wider part positioned medially, is continued by the muscle tissue of the nipple from its base (Figure 1).

Lactiferous ducts (Figure 1 – mld), from all parts of the mammary gland converge toward the center of the areola, above which is the base of the nipple, and just before, become significantly widened into lactiferous sinuses (Figure 1 – ls). The lactiferous sinuses proximally give rise to narrower ductal structures (35), papillary ducts (Figure 1 – dp), of which one or two may merge with each other, and at the level of their penetration through the openings of the nipple base smooth muscle meshwork, become highly grouped, even "bundled" (26), which is known as a "waist" (12, 28).

Dabelow (19) defines zonal organization of the areolar part of the muscle:

1) the inner muscular ring (at the base of the nipple) (Figure 1 – ic),

2) the wide, tangential, intermediate zone (Figure 1 – it), and

3) the outer muscular ring (Figure 1 – oc), whose muscular bundles, in their distribution, detours around Montgomery`s glands (19).

Vorherr, (3) as a successor of Dabelow, explained: "The muscle fibers around the nipple (base) show a circular course, and from the nipple basis inner tangential, stronger fibers (intermediate muscle layer) leave to form a circumferential fiber meshwork at the periphery of the tissue fibers, thus, creating counter-directed double spirals before inserting as tendinous fibers on papillae of the adjacent corium. This fiber arrangement allows a concentric diminution of the size of the areola mammae as necessary".

The innermost part of the areolar muscle, which latter Dabelow (19) classified as inner muscular ring, previously described by Eggeling (33) as individually varying, circularly oriented smooth muscle tissue, also implying the association with the so-called papillary furrow (Figure 1 – pf), a shallow, ring-shaped furrow of skin, which often separates the root of the wart from the areola.

Additionally, Marcacci (10), Henle (40), Henning (41), Rieffel (39) and Eggeling (33), also described the continuation of areolar smooth muscle bundles, and their extension under the nipple base, taking tangential and slightly curved direction, criss-crossed, positioned just peripherally (above) to lactiferous sinuses, and therefore forming the basket-woven, diaphragm-like plate, through which, without direct contact, papillary ducts are passed. To this diaphragm-like muscular meshwork in the center of the areola, we would like to propose the term, "central areolar feltwork" (Figure 1 – caf), composed of smooth muscle bundles which are extending tangentially between different parts of the areola muscular inner circle, located just between the superficial parts of the lactiferous sinuses, and the proximal parts of the papillary ducts. The papillary ducts continuing distally from the lactiferous sinuses aggregate below this region giving the aspect of narrow "waist" (12, 28) before are passed through this "central areolar feltwork" toward the structure of the nipple.

Often, in numerous textbooks, as well as in introductory texts of research articles, eponyms are used: Sappey`s muscle (Figure 1 – Sm) for circularly organized, and superficially positioned, as well as Meyerholtz`s muscle (Figure 1 – Mm) for deeper located, and radially oriented bundles of the areolar smooth muscle tissue. However, it is interesting that in newer and contemporary literature, the referencing is almost always circumstantial, without quotation of the primary sources. The Meyerholtz`s surname was associated with the radial component of the areolar muscle by Henle in his textbook of Anatomy (40), who worked in the same Institute where Meyerholtz did his investigations. Again, the name was established as the eponym also by Rieffel (39, 42). Neither Henle nor Rieffel quote a published source (42). Furthermore, Marcacci in his article (10) very meticulously analyzed and discussed the structure of the nipple-areolar muscle, and also cited Henle`s credit to Meyerholtz (40). However, it is interesting to mention here, that Marcacci in that article cited Meyerholtz`s surname with transliteration, as Mayerholz. Meyerholtz`s surname was also occasionally cited, through the literature of 20th up to the articles of 21st century, as "Meyerholz". In the

case of Sappey`s eponym, the original description of the areolar muscle was recorded in Sappey`s textbook of anatomy *"Traité d'Anatomie descriptive"* (35). However, in specialized literature dedicated to systematization of eponyms, direct explanation who and when introduced Sappey`s surname as the eponym associated with the structure is not given by specialized publications (42, 43). It seems to us that most probably the use of Sappey`s surname as the eponym for circularly oriented bundles of the areolar muscle was firstly introduced by Rieffel in Poirier`s textbook of Anatomy (39). Finally, we also should be grateful to Rieffel (39), for his precise systematization of the literature results associated to the topic of the nipple-areolar complex muscle tissue, during which he introduced the third eponym "Marcacci`s muscle" for designation of smooth muscle tissue of the nipple-areola complex, which Marcacci (10) analyzed in details, and advocated that the muscle of the complex (areola and nipple) was one inseparable anatomic unit. The term was also later cited by Dobson (42).

Specific morphology of the nipple part of the muscle

The nipple part of the complex muscle is a conical structure, as Marcacci (10) stated, nothing other than the areolar portion molded into the interior of the nipple, so that the muscle part of the areola, at the base of the nipple is introduced (like a finger in a finger cot) into the skin of the nipple, taking, like the latter, a conical shape. However, the muscular component of the nipple has its own specific complexity which could be classified in three different entities:

1) the bulk of the musculature which is composed of circularly oriented smooth muscle bundles, organized in multilayered meshwork, positioned in the reticular dermis of the lateral sides of the nipple integument (muscular wall, muscular columns) (Figure 1 – mc),

2) the nipple tip sphincter feltwork (Figure 1 – smf), and

3) the axial (middle, inner) nipple zone (Figure 1 – anz), with longitudinally (Figure 1 – lb) and transversely (Figure 1 – tb) oriented, scarce smooth muscle bundles.

The fibers which form the external part of the muscle, or the external muscular wall (Figure 1 – mc), intersect and place themselves on the top of each other in a very regular way, forming quite compact nipple muscle cone well accentuated especially in women, where it goes from the base to the upper third of the nipple, being thicker at the bottom than the top (10).

In the upper portion, that is to say at the tip of the nipple, muscular nipple is organized as the muscular mesh (feltwork), leaving spaces which are traversed by the papillary ducts, where these conduits may be tightened by the muscular mesh as by a sphincter (Figure 1 – smf). At this point, the relations of the skin with the muscle and the milk ducts are very close. This plate-like feltwork is supported by the proximal two-thirds of the exterior muscular wall (10). Muscular sphincter feltwork is composed of ramified and ten times narrower bundles than those in lateral parts of the nipple muscle (19, 44).

The muscular wall (Figure 1 – mc) of the nipple appears as a thick muscular cylinder, which is continuation of the innermost part of the areolar muscle at the base of the nipple, and in the region of the nipple tip, "covered" with plate-like part of the muscle (Figure 1 – smf), arranged in a sphincter-like fashion (1), intermingled between ending parts of the papillary ducts. When taken into consideration that the center of the nipple base is also bordered with diaphragm-like muscular meshwork (Figure 1 – caf), the muscular part of the nipple could be described as a barrel like structure through middle part of which, papillary ducts are traversing longitudinally. For this central part of the nipple, encircled with the nipple muscles on lateral sides (Figure 1 – mc), distally with the sphincter feltwork of nipple tips (Figure 1 – smf), and toward the base with "central areolar feltwork" (Figure 1 – caf), we would like to propose the term "axial nipple zone". This "axial nipple zone" (Figure 1 – anz), is occupied by papillary ducts, surrounded by stretchable and mobile fibro-elastic connective tissue (3, 11), in which are disposed longitudinal (Figure 1 – lb) and transverse (Figure 1 – tb) bundles of smooth muscle tissue. Longitudinal bundles of the axial nipple zone (Figure 1 – lb) extending from the base of the nipple (and its areolar "diaphragm" – "central areolar feltwork") toward the nipple sphincter feltwork. The transverse bundles (Figure 1 – tb) are short, extending from the inner side of the muscular wall, and traversing perpendicularly between papillary ducts of the nipple (10, 19, 32, 34, 37). None of the smooth muscle bundles positioned in feltworks (of the areola or nipple) take close physical relation to or are integrated in the walls of the papillary ducts, rather leaving the openings through which these ducts are passed. It is the same for the longitudinal or the transverse bundles of the axial nipple zone (10, 19, 34). A mechanism consisting of smooth muscle and elastic fibers acting as a sphincter at the end of the ducts in the nipple appears to prevent most unwanted loss of milk (1, 11). Musculature, fibro-elastic tissue, and the rest of the complex integument of the complex are involved in processes of breastfeeding as well as in the protection of ductal structures from its shearing stress. The axial zone of the nipple is less "muscular" and its fibro-elastic tissue provides a degree of elastic deformation, which combined with contactless passage of papillary ducts trough the openings of the muscular feltworks, permits partial axial mobility of papillary ducts. As early dissection results evidenced (19, 38), the "loose" interior of the nipple, provides that after the nipple tip is severed, ductal structures of the nipple could be stretched for few millimeters. The fact that papillary ducts are "stretchable" inside muscular "box" of the nipple, limited anteriorly with muscular sphincter feltwork of the tip, and posteriorly, above lactiferous sinuses, with central areolar feltwork, may indicate to the biomechanical system which, during breastfeeding functions as double, unidirectional valve.

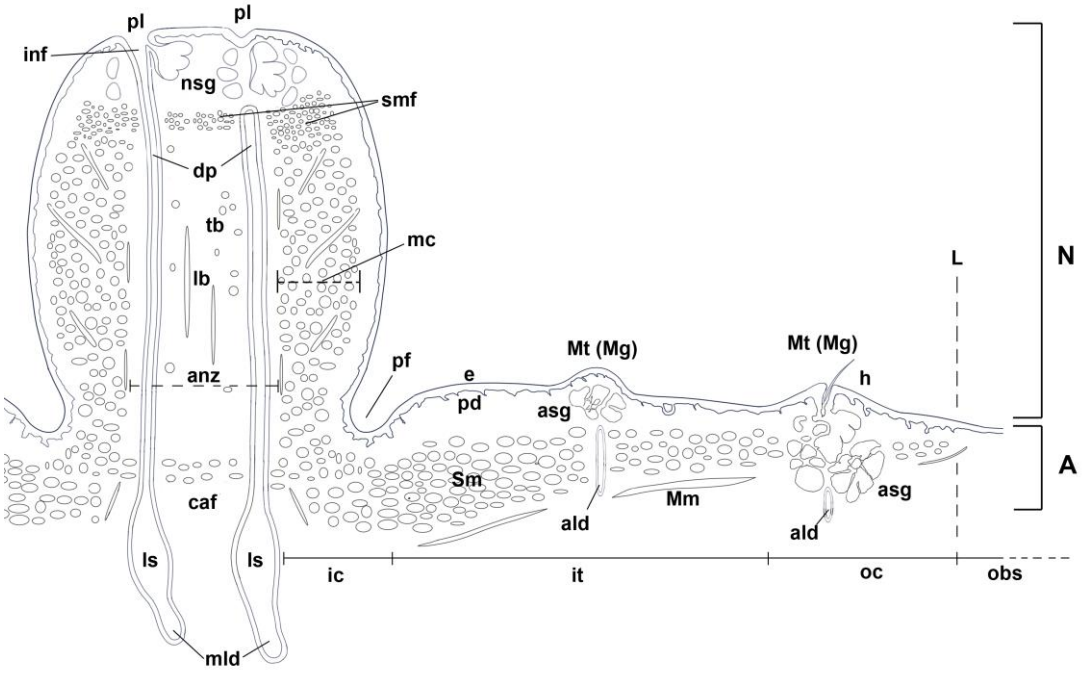

Figure 1. Areolar-nipple complex

A - areola;
N - nipple;
pf - papillary furrow;
L – areolar limbus;
obs – unspecific thin hirsute skin of a breast;
e – epidermis;
pd – papillary dermis;
Mt -Morgagni`s tubercles and Mg - Montgomery`s glands (with own lactiferous ducts – ald);
asg - sebaceous glands of Montgomery`s glands;
h - hair;
mld - lactiferous ducts of mammary gland(s);
ls - lactiferous sinus (ampulla);
dp - papillary duct;
inf - infundibulum of papillary duct;
pl – opening of nipple ducts;
nsg - sebaceous glands of nipple tip;
ic – inner,
it – intermediate;
oc - outer areolar zone;
Sm - circularly oriented bundles of smooth muscle tissue in areola;
Mm - radially oriented bundles of smooth muscle tissue in areola;
caf – central areolar feltwork, smooth muscle bundles of the nipple base;
anz - axial nipple zone;
lb - longitudinal muscle bundles of axial nipple zone;
tb - transversal (interstitial) muscle bundles of axial nipple zone;
mc – nipple muscle wall (circular bundles of muscle columns, tangential bundles of muscle columns);
smf - smaller bundles of papillary sphincter smooth muscle tissue feltwork.

Conclusion

The nipple-areola complex is a unique anatomical structure, characterized by the glabrous skin with a specific adnexa (Montgomery`s glands, and the nipple tip sebaceous glands), equipped with the integumentary class of the smooth muscle tissue, intermingled with the fibro-elastic connective tissue of the reticular dermis, with a major role in regulation of milk through the ending components of the mammary gland ductal system (papillary ducts), opening at the tip of the nipples. The nipple areola muscle is one impartible anatomic unit, organized as a multilayered muscular meshwork, however having specific topographical organization. In the areola, there are recognizable peripherally positioned, with circularly oriented smooth muscle bundles (Sappey`s muscle), and deeper are radially oriented bundles of Meyerholtz`s muscle. Peripherally to the papillary furrow, the areolar muscle could be divided into three zones:

1) inner muscular ring (at the base of the nipple),
2) wide, tangential, intermediate zone, and
3) outer muscular ring.

Additionally, just below the nipple's center, bundles of areola smooth muscle tissue form a basket-woven, diafragm-like plate, through which, without direct contact, papillary ducts are passed, and to which we propose the term "central areolar feltwork".

The nipple part of the complex is organized in three components:

1) the nipple muscular wall (in the reticular dermis of the lateral sides of the nipple integument),
2) the nipple tip sphincter feltwork, and
3) the axial nipple zone, with longitudinally and transversely oriented scarce smooth muscle bundles.

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GLATKOMIŠIĆNO TKIVO AREOLARNO-MAMILARNOG KOMPLEKSA

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Centralna pozicija integumenta dojke se karakteriše prisustvom, kružne, glabrozne (bezdlake), muskulo-kutane specijalizacije, areolarno-mamilarnim kompleksom, specifičnim po prisustvu integumentarne klase glatkomišićnog tkiva, čiji su snopovi utkani u fibro-elastično tkivo retikularnog derma, a otvori distalnih, završnih delova ekskretornog duktalnog sistema mlečne žlezde, smešteni u vršnom delu bradavice dojke. Unutar ovog specifičnog kompleksa kože dojke, sačinjenog od dva anatomski prepoznatljiva činioca, mišićno tkivo je kontinualnog prostiranja, i pruža se kroz areolu i bradavicu, funkcionišući kao jedinstvena anatomska jedinica. Iako prisutna kod osoba oba pola, u fiziologiji ženskog organizma, tokom reproduktivnog perioda života, značano biva razvijenija i pored uloge u reakcijama polnog uzbuđenja, glavna funkcija ove strukture je tranzitorna kontraktilna aktivnost, kao deo fiziološkog mehanizma kojim se obezbeđuje kontrolisano oslobađanje mleka tokom procesa dojenja. Još tokom istraživanja sprovedenih tokom devetnaestog veka, ova struktura je analizirana i definisana do detalja, ali je kasnije, u uobičajenim udžbenicima anatomije i histologije zapostavljena zbog predrasude o marginalnosti značaja. Shvatajući potrebu za didaktičkom rekapitulacijom i sistematizacijom podataka vezanih za muskulaturu i pridružene strukture ovog kompleksa, ovde je predstavljen pregled dostupne literature, naročito iz onih izvora, koji su bili od značaja za razvoj teme, ali su ređe bili predstavljani u savremenoj naučno-stručnoj publicistici.

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Ključne reči: *areola, bradavica, glatkomišićno tkivo, Sappey, Meyerholtz*

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