Manual Therapy, Posturology & Rehabilitation Journal
formerly REVISTA TERAPIA MANUAL

RESEARCH ARTICLE

http://dx.doi.org/10.17784/mtprehabjournal.2016.14.389

Thermography study of nipple-areola complex in immediate puerperas

Maria Ferreira di Migueli[1], Soraia Cristina Tonon da Luz[1], Keyla Mara dos Santos[1], Gesilani Julia da Silva Honório[1], Thuane da Roza[1,2]

ABSTRACT

Introduction: In the puerperium period, one of the main causes for discontinuation of breastfeeding is breast changes. The fissure is characterized by a skin lesion in the nipple-areolar complex, a consequence of an error in the breastfeeding. **Objective:** The present study aimed to identify the surface temperature of the nipple-areola complex of the lactating breast, with and without fissure, establishing a comparison with a group of nulliparous women. **Method:** The sample consisted of thirty women, forming three groups: G1- puerperae with breast fissure; G2- puerperae without breast fissure; and G3- nulliparous. The evaluations were carried out at public Carmela Dutra Maternity of Florianopolis (SC), consisting of: interview, inspection and thermographic examination of the anterior view of the breasts. Nulliparous were evaluated at the Santa Catarina State University. **Results:** Increased vascularization was observed in G1 and G2, including the nipple-areola complex, mainly in G2. Seven women of G1 and eight of G2 presented warmer and vascularized areolar region when compared to the nipple. The nulliparas presented different thermal image, with smaller number of areas with delineations of blood vessels. Statistical differences were observed between groups at the minimum temperature in the areola (p=0.007) and in the nipple (p=0.037). When comparing the mean temperatures between the groups, there was a statistical difference between G1 and G3 in both regions (p=0.005; p=0.047). The G1 presented lower temperature in the nipple region. **Conclusion:** The group with fissure had lower values of superficial temperature compared to the others, which could be associated with a vascular alteration process, and the thermographic evaluation made it possible to identify physiological and structural modifications of the breast. As a non-invasive technique, thermography can be a tool in the monitoring of physiological anatomical changes of the breast, as well as in the identification of problems related to lactation difficulty, opening doors to new studies about the subject.

Keywords: Fissure; Mama; Puerperium; Thermography.

INTRODUCTION

Gestation and all related events, such as the puerperium and lactation, bring great changes to the woman's life, and the most perceived ones are those related to corporal modifications.(1) Such events produce greater vulnerability for women, who need an integral approach.(2)

The immediate puerperium is a period of great importance for the mother and the baby, because it is a moment that all maternal-fetal adaptation will take place, making assistance to this binomial a fundamental condition. Thus, the immediate postpartum care and recommendations are intended to promote the well-being of the puerperal woman, as well as to prevent, recognize and treat possible complications.(3)

In this period, one of the primary actions of the health professional is the incentive to breastfeeding with its innumerable benefits, from the promotion of growth and development of the child with reduction of infant morbidity, to a better affective and psychological relationship between mother and baby.(4,5) In this sense, the performance of the professional should be directed to the training of the woman with appropriate conduits, in order to avoid problems that could harm the act of breastfeeding.(6)

According to the Ministry of Health in Brazil, it is observed that even if the onset of breastfeeding is adequate in the first days of life, more than half of the children are no longer exclusively breastfed after the first month of life.(7) According to Assis(8), one of the main causes of discontinuation of breastfeeding is breast changes such as fissures and engorgement.(8) The Nipple trauma is characterized by a skin lesion in the nipple-areolar complex, a consequence of an error in the breastfeeding.(9)

Corresponding Author: Name: Keyla Mara dos Santos. Address: Rua Pascoal Simone, 358 - Coqueiros - Florianópolis – SC, CEP: 88080-350. Telephone:+55 (48) 3664-8670 / (48) 3664-8653. E-mail: keylasantosfisio@gmail.com

[1] Health and Sport Sciences Center (CEFID), State University of Santa Catarina (UDESC), Florianópolis (SC), Brazil.

Full list of author information is available at the end of the article.

Financial support: None.

Submission date 3 September 2016; Acceptance date 4 December 2016; Publication date 22 December 2016

The most common factors that cause nipple trauma are the non-efficient suction and the use of lubricants in the breast that remove the surface cells from the areola making the region more sensitive and delicate.[8] Normally, nipples with fissures are characterized by the presence of linear ulcerations or lesions in continuity with commitment of the epidermis or dermis, located at the nipple-areolar junction or at the surface of the nipple. Once installed, nipple trauma is very painful and often preclude mothers from breast-feeding.[7,8]

As human temperature is a vital signal that can be measured in a single point (oral, axillary, rectal, visceral, esophageal, tympanic) or in several cutaneous points (thermography), it is possible to know and control body thermoregulation and the diseases related to it, thus, being able to be used for the breastfeeding complications.[10]

Infrared thermography has been assuming an increasingly important role as a safe method capable of analyzing the perfusion state of the organic tissues in several different situations, through determinations of superficial skin temperatures.[10]

In order to assess the immediate postpartum lactating women, this study aimed to identify the surface temperature of the nipple-areola complex, with and without fissures, establishing comparison with group of nulliparous women.

METHODS

This is an experimental, analytical descriptive study. In order to evaluate the breast, a data collection protocol was developed for immediate puerperae with and without fissures using thermography as an evaluation tool.

Thirty women participated in the study, 20 of them were in the immediate puerperium and 10 were nulliparous. The puerperae obeyed the following inclusion criteria: primiparas, with and without breast fissures, with age between 18 and 35 years. For inclusion in the third group, the woman should be nulliparous, presenting the same age group as the puerperae. As criteria for the exclusion of the participants were considered: changes associated with breastfeeding, such as engorgement, mastitis and breast abscess (in the case of postpartum women); presence of accessory breast; previous production of milk; women with scar or previous surgery performed on the breasts, whether of aesthetic or pathological etiology; breast diseases such as cysts, dysplasia or neoplasia. Thus, three groups were divided: G1 was composed of 10 primiparas women with fissure, G2 with 10 primiparas women without fissure and G3 with 10 nulliparous.

Data collection was performed between February and April 2012, at the public Carmela Dutra Maternity and the clinic school of physiotherapy at the State University of Santa Catarina (UDESC), both institutions located in Florianopolis (SC).

Firstly, for the puerperae, the triage was performed by analyzing the medical records in the units, followed by the first contact with each participant, explaining the study and the procedures to be performed. The participant ratified her participation with the signing of the Informed Consent Term. In the case of nulliparous, the selection was made through an invitation to the students of the physiotherapy course of UDESC, respecting the inclusion and exclusion criteria.

Initially, an evaluation form was applied to all groups and adapted to the nulliparous, with questions regarding personal data, history of diseases, type of birth, use of medications and preparation of the breasts during pregnancy.

In order to perform the thermographic images, the puerperae were individually referred to a room in the institution where the thermographic camera was mounted to collect the images. The collection room was with a controlled temperature (between 23°C and 25°C), without any interference from the sunrays. The nulliparous were evaluated in a room of the clinic school of physiotherapy in UDESC, provided with the same temperature.

For the collection of images was used the *Electrophysics* thermographic camera (PV 320 T model, EUA), suitable for the application of the functional diagnosis, with digital image processing, thermal sensitivity of 0.08° and spectral range of 3 to 14 micrometers.

The images were made with a distance of approximately 60 cm from the participant, who was placed in the chair, with breasts exposed, remaining in this condition for 15 minutes for acclimatization. In the case of puerperae, the images were performed with a period of at least 20 minutes of interval from the last feeding.

The images of each breast separately were captured. In order to establish the surface temperature of the nipple-areola complex were drawn regions of interest (R) of circular shape in which were delimited the nipples (R1) and the areolas (R2) of the two breasts, obtaining the mean, maximum and minimum temperatures of each R (Figure 1).

For the analysis of the temperature valueswas used the ThermaCAM Researcher Pro 2.10® program and for the evaluation of the thermographic images was used the FLIR QuickReport® program.

The Committee on Ethics and Research in Humans of Carmela Dutra Maternity approved this study, with number 481.326, being respected the resolution 466/12.

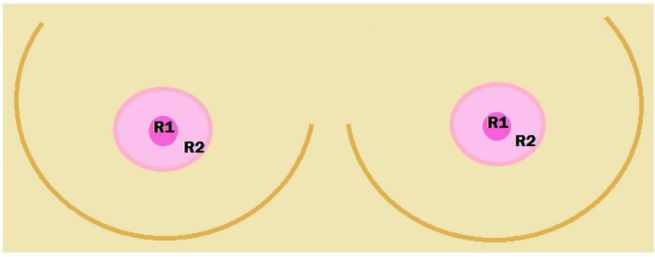

Figure 1. Regions of interest (R), nipple (R1) and areola (R2).

The interview and temperature data were organized in spreadsheets of the Microsoft Excel program. Subsequently, these data were exported to the program SPSS for Windows®, version 20, being made descriptive and inferential analysis.

For the analysis of nulliparous and puerperae without fissure, the mean values of the two breasts were considered for the variables maximum, minimum and average temperature of the regions of interest. In the case of the values of puerperae with cleft, the values to be considered were those of the breast that presented this condition.

The ANOVA test was used to identified the differences between groups. Then, when there was a difference between the temperatures of the groups, was made the *post hoc* through the Tukey test. All tests used a significance level of 0.05.

RESULTS

The mean age of the patients in the three groups was 24.7(±3.3) years (ranging from 18 to 33). Table 1 establishes the results obtained from the interview with puerperal women.

In the inspection of the breasts and the data collected by the evaluation form, was observed that all had protruding nipple in relation to the G3. The participants of this group did not indicate a history of diseases, and nine of them used oral contraceptive hormonal. In the G1, 5 women showed bilateral fissure, 3 showed only in the left breast and 2 only in the right breast. The alterations found after the analysis of the thermographic images (figure 2) are shown in the table 2.

When evaluating the images of the breasts of groups G1 and G2, it was possible to observe (Figure 2 and Table 2), in general, a symmetry of colors between the right and left breasts. In G2 was identified that two women had thermal asymmetry, this fact may be characterizing a difference in the focal vascularization when comparing one breast to other. There is also an increase in vascularization throughout the breast in both groups of lactating women. This characteristic was observed through color differences (red and white) with intense superficial vascularization, mainly in G2, characterized in the form of lines and branches throughout the mammary gland (Figure 2).

When evaluating the nipples region, it was noticed that in G1, the appearance of color difference (temperature) was predominant (seven women) in relation to the areola, observing that the areolar region was warmer and vascularized and the nipple region was with lower temperature. In G2, this difference was also identified in eight participants; however, even with lower nipple temperature it was closer to the areolar region.

The nulliparous group presented, in general, a different image when compared to the other groups, since the breast presented with a smaller number of areas with blood vessel delineations. In only two women it was possible to observe a greater vascularization in the nipple-areola region. The common similarity observed between the control group and the other groups was related to the areola, highlighting colors and indicating warmer temperatures in relation to the nipple. Only one participant in G3 presented an asymmetry when comparing right breast with left breast individually.

Table 1 – Frequency of the results obtained through the application of the evaluation form performed with G1 (with fissure) and G2 (without fissure).

Characteristics	(G1)	(G2)
Cesarean Section	6	3
Normal birth	4	7
Preparation of the breast using materials (loofah, towels)	4	0
Sunbath	1	0
Use of ointments or creams	1	0
Increased breast volume	10	8
Both breasts offered	5	6
One of the breasts most offered	3	2
Pain or discomfort when breastfeeding	10	2
Semi-Protruding Nipple	2	1
Protruding Nipple	8	9

Source: Assessment form used in the study.

Table 2 – Frequency of alterations found after analysis of thermographic images.

Features of thermographic image	G1	G2	G3
Color symmetry bilaterally	10	8	9
Increased vascularization of the nipple-areola complex	10	10	2
Delimited nipple with lower temperature compared to areola	7	8	9
Delimited nipple with higher temperature compared to areola	3	2	1

Source: Thermographic images viewed in the FLIR QuickReport® program.

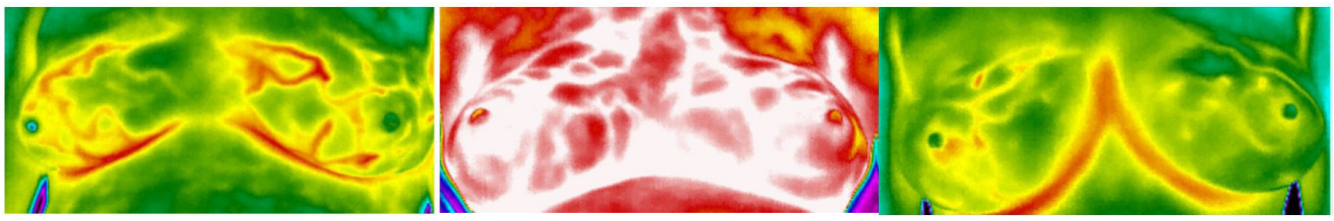

Figure 2. Examples of thermographic images, from left to right: breast with fissure, breast without fissure and nulliparous.

Table 3 – Difference of temperature between control, fissure and non- fissure groups in the areola and the nipple region.

	Temperature	G1	G2	G3	Value of *p*
		(Mean ± SD)	(Mean ± SD)	(Mean ± SD)	
Areola	Minimum	33.55 ± 0.22	34.10 ± 0.43	35.20 ± 0.32	0.007*
	Maximum	37.01 ± 0.12	36.90 ± 0.23	37.20 ± 0.20	0.486
	Average	35.30 ± 0.11	35.50 ± 0.37	36.06 ± 0.23	0.126
Nipple	Minimum	34.00 ± 0.42	34.20 ± 0.46	35.50 ± 0.37	0.037*
	Maximum	36.70 ± 0.30	36.30 ± 0.21	36.90 ± 0.27	0.284
	Average	35.30 ± 0.32	35.30 ± 0.39	36.06 ± 0.28	0.199

* ≤ 0.05 ANOVA test.

Table 4 - Comparison of the value of minimum temperatures between groups.

	Areola	Nipple
	(value of *p*)	(value of *p*)
G1 X G2	0.496	0.940
G2 X G3	0.075	0.093
G3 X G1	0.005*	0.047*

* ≤ 0.05 Tukey test.

Regarding temperature values, there was a statistically significant difference between groups G1, G2 and G3 in the minimum nipple temperature (p=0.037) and the minimum areola temperature (p=0.007). The mean and standard deviation (SD) of the minimum, maximum and average temperatures of each region are shown in the table 3.

The G1 presented lower values of temperature in the areola and the nipple region when compared to G3, with a statistically significant difference (Table 4).

DISCUSSION

The present study described the thermographic characteristics of the nipple-areola complex in immediate lactating puerperae with and without nipple fissure compared to the breast of nulliparous women. According to Chaves[11] in the immediate postpartum period, between 24 and 48 hours after birth, there is the flow of milk. During this period innumerable hormonal changes occur, making the breasts bigger, heavier and slightly warmer, and may have more salient veins. Through the qualitative analysis of the breasts of the G1, G2 and G3, can be observed these changes through the thermographic images, in which was possible to notice a significant increase of the vascular network in the breasts and the nipple-areola complexes in groups G1 and G2, mainly in G2, when compared to G3 (nulliparous).

In the G1 and G2, 100% of women showed vascular increase, whereas in G3 was observed in only 10% of the breasts, but visually less than the highlighted by women in the breastfeeding process. In general, the qualitative vascularization of women without breast fissure was with warmer stains. This fact may characterize that women without fissure are comfortable during the breastfeeding mainly because they do not present pain, therefore, they offer the breast more to the infant and they release more hormones possessing a thermographic image that highlights a breast with great metabolism and milk production.

The rich sensory innervation of the breast, particularly the nipple and areola, is of great functional importance because the infant initiates a chain of neural and neurohumoral events when suckling that result in the release of milk and the maintenance of glandular differentiation, which is essential for continued lactation [12]. When analyzing the nipple-areola complex, it was observed that 100% of women in the G1 and G2 reported increased size and darkening in the region. According to Palter [13] during pregnancy, the nipple-areola complex darkens and increases in size, due to the synergistic action of several hormones, the main ones being estrogen, progesterone and prolactin. The same author points out that one of the actions of these hormones is the development of alveoli at the ends of the terminal interlobular ducts.

Qualitative differences were observed in the 3 groups, in which 70% of the G1, 80% of the G2 and 90% of the G3 presented the nipple region with cooler thermographic characteristics when compared to the areolar region. This fact may be related to the decrease of blood vessels and secretory glands in the nipple region when compared to the areola region or even the characteristic of the nipple type, due to the distal (protrusion) related to the areolar region.

In this study, 20% of the G1 and 10% of the G2 presented the semi-protruding nipple. According to Polden[14], the anatomy of the nipple can come in four different types. Semi-protruding nipple, which it presents a little protrusion as if it were incorporated to the areolar region; flat nipple, it is on the same level as the areola; protruding nipple, which is protruding and in different planes of the areolar region; and inverted nipple, characterized by total inversion of epithelial tissue, which can cause complete disappearance of the nipple.

Among the preventive factors to the onset of breast fissure are the care of the breast during pregnancy, proper grip of the infant during breastfeeding and the types of nipple.[15] When evaluating G1 and G2, it was observed that none of the women evaluated in G2 (primiparas without

fissure) had previous care of the breast during gestation and in G1 (primiparas with fissure) 40% of them performed prior breast care. Aiming, in the present study, that the previous preparation of the breast for lactation did not prevent breast fissure. Almeida[15] tells us that the physical preparation of the breasts has not been shown to be beneficial and has not been routinely recommended. Exercises to the nipples during pregnancy most often do not work, can be harmful, and may induce labor due to stimuli and hormonal release leading the uterus to a premature contraction. However, when we analyzed the correct handgrip of the infant in the breast, 100% of the primiparas of G1 had difficulty in correctly positioning the baby. Among the approaches, that aim to contribute to the prophylaxis of nipple lesions, is an important relation between the correct suction of the newborn to the maternal breast.[15] The same author also establishes that the proper positioning of the baby, the correct handle and proper removal of the newborn at the end of the feeding (placement of the finger at the corner of the baby's mouth), helps combating the nipple fissure. In the correct handle, the baby performs a wide mouth opening, grabbing not only the nipple but also part of the areola, forming a perfect seal between the oral structures and the breast. The baby's jaw rests on the lactiferous breasts, and the baby grabs the nipple and approximately 2 to 3 cm of areola.[16]

Breast fissures are due to small damage to the epithelial tissue, and can be classified into three types. Small fissures, which do not exceed 3mm in diameter and cause pain only to suction; Medium fissures, which do not exceed 6mm and cause pain to suction; And large fissures, which are characterized when the trauma exceeds 6mm in diameter, leaving the nipple very sensitive and painful throughout breastfeeding.[17] Nipple trauma is one of the main causes that lead to early weaning and, therefore, its prevention is very important.[18] After the fissure is installed, the woman should seek treatment, as it is extremely painful and a port of entry for bacteria. So in addition to eliminating and correcting the cause of the problem, it is necessary to intervene to eliminate the pain and promote the healing of the injuries as soon as possible.[19]

Commonly, inflammatory mediators act locally in order to reduce the consequences and extent of tissue damage.[20] According to Giugliani[18] The chemical vascular activity is always greater in tissue with inflammatory processes, as well as its surrounding area, than in healthy tissues, leading to a local increase in temperature. These qualitative and quantitative differences in the nipple-areolar complex observed in the present study were related to physiological changes in the breast during lactation and not to breast trauma. Thus, the modifications occurred due to the synergistic action of several hormones during gestation, which produce a great neoformation of alveoli, as well as a proliferation of the lactiferous ducts, establishing a great increase of the breast vascularization, when compared the breast of lactating women with the nulliparous.

Regarding the differences in temperature (asymmetry pattern) in the regions of interest, differences of almost two degrees Celsius were observed between the three groups when compared (R2-R2) between the G1 and G3 (table 3), these differences highlighted a colder nipple region when compared to the areola in the group with nipple fissure (G1). Such a thermal difference in the nipple region may have been due to milk accumulation, since due to the pain, there is a difficulty for the mother to breastfeed in the fissured breast, causing lactic stasis in the galactophore ducts.[19] Perhaps this fact explains the decrease in temperature in this region, in which the accumulated and externalized milk in the nipple stabilizes more easily with the environment presenting with a lower temperature (23ºC to 25°C). Another question is the anatomy of the extremely innervated nipple with connective tissue and venous features of essential substance typical of the erectile organs, which in contact with the milk at lower temperature (room), cools rapidly.

As a limitation of the study, the fact that the nipple-areolar complex is a small area, R1 encompassed R2, and it is not possible to exclude the temperature of the nipple for isolated analysis of R1. In this way, the qualitative analysis of the images (table 2) becomes relevant, since, we can investigate in a functional way the problem in question. In this analysis, we observed that, in the majority of the sampling, the nipple presented well delimited and with lower temperature in relation to the areola.

Considering the great contribution, that the infrared image has shown for years, about the diagnoses of the breast [21], we can highlight the considerable scientific relevance that thermography brings to women's health, pointing out as an important and non-invasive diagnostic tool for new studies on the theme of this study.

CONCLUSION

It was possible to describe the thermographic characteristics of the nipple-areolar complex, in a quantitative and qualitative way, in the immediate lactating women with and without nipple fissure compared to the breast of nulliparous women. The exact location and extent of nipple fissure had not been established clearly and with a higher temperature, as we would normally associate, when comparing the different groups. This fact can be related to several factors, such as lesion size, sensitivity of the thermographic machine, limitation in the exclusion of nipple temperature for isolated analysis of R1, anatomical and physiological characteristics of the fissured and non-fissured nipple. The thermographic functional investigation enabled us to identify the main physiological and structural changes of the breast during the lactation period, comparing with the non-lactating breast. Thermography as a non-invasive technique, unlike other clinical exams, is not harmful to the pregnant and to the lactating breast, and may be an important tool in the follow-up of the anatomo-physiological

modifications of the breast during pregnancy, as well as in the identification of problems related to the difficulty of lactation, opening possibilities to new studies about the subject.

AUTHOR'S CONTRIBUTION

MFM: Design and planning of research project and data collection. SCTL: Design and planning of the research project, writing and critical review. KMS: Writing, critical review and interpretation of data. GJSH: Analysis and interpretation of data. TR: Data analysis and final writing.

CONFLICTS OF INTEREST

The authors declare no have conflicts of interest.

AUTHOR DETAILS

[2] INEGI, Faculty of Engineering of the University of Porto, Portugal.

REFERENCES

1. Albino MAS, Moccellin AS, Firmento BS, Driusso P. Gait force propulsion modifications during pregnancy: effects of changes in feet's dimensions. Rev Bras Ginecol Obstet. 2011;7(33):164-9.
2. Vieira SM, Bock LF, Zocche DA, Pessota CU. Perceptions among pregnant women on pre-natal care provided by the health team. Texto Contexto Enferm. 2011;esp(20):255-62.
3. Liz AN, Magalhães GM, Beuttenmüller L, Bastos VPD. Fisioterapia no Período Puerperal: Revisão Sistemática. CORPVS/Rev dos Cursos de Saúde da Faculdade Integrada do Ceará. 2013;1(27):09-20.
4. Verret-Chalifour J, Giguère Y, Forest JC, Croteau J, Zhang P, Marc I. Breastfeeding initiation: impact of obesity in a large Canadian perinatal cohort study. PLoS One. 2015;10(2):1-13.
5. Hassiotou FHP. At the dawn of a new discovery: the potential of breast milk stem cells. Adv Nutr. 2014;5(6):770-8.
6. Ito S. Chronic illness and the breastfeeding mother. J Popul Ther Clin Pharmacol. 2014;21(3):565-8.
7. Saúde MD. Pesquisa Nacional de Demografia e Saúde da Criança e da Mulher – PNDS 2006: dimensões do processo reprodutivo e da saúde da criança. . Brasília. 2009.
8. Assis EA. Difficulties faced by primiparous puerperal regarding the exclusive breastfeeding. Revista Eletrônica Gestão & Saúde. 2014;5(3):808-19.
9. Almeida JSG. Dificuldades das puérperas adolescentes para amamentar: Revisão sistemática. Universidade Estadual da Paraíba. 2014:18.
10. Souza GAGR. Reference breast temperature: proposal of an equation. Einstein (São Paulo). 2015;13(4):518-24.
11. Chaves RG, Lamounier JA, César CC. Factors associated with duration of breastfeeding. Jornal de Pediatria. 2007 jun;83(3):241-6.
12. Viana LC. Ginecologia. 2o ed. Rio de Janeiro: Medsi; 2002.
13. Palter SF, Olive DL. Fisiologia Reprodutiva. 13o ed. Rio de Janeiro: Guanabara Koogan; 2005.
14. Polden M, Mantle J. Fisioterapia em Obstetrícia e Ginecologia. São Paulo: Santos; 2000.
15. Almeida NAM, Fernandes AG, Araújo CG. Aleitamento materno: uma abordagem sobre o papel do enfermeiro no pós-parto. Rev. Elet. de Enfermagem. 2004;6(3).
16. Sanches MTC. Clinical management of oral disorders in breastfeeding. Jornal de Pediatria. 2004 nov;80(5):s155-s162.
17. Freitas F, Martins-Costa SH, Ramos JGL, Magalhães JA. Rotinas em Obstretícia. 5o ed. Porto Alegre: Artmed; 2006.
18. Giugliani ERJ. Lack of scientific evidence for the treatment of nipple traumas. Jornal de Pediatria. 2003 jun;79(3):197-8.
19. Giugliani ERJ. Common problems during lactation and their management. Jornal de Pediatria. 2004 nov;80(5):s147-s154.
20. Guyton, Arthur C. Fisiologia Humana. 12o ed. Rio: G; 2008.
21. Brioschi ML, Teixeira MJ, Silva FM, Colman D. Principios e indicações da termografia médica. 1o ed. São Paulo: Anreoli; 2010.