Lactic acid chemical peel in the treatment of melasma: clinical evaluation and impact on quality of life

Peeling de ácido láctico no tratamento do melasma: avaliação clínica e impacto na qualidade de vida

Original Article

ABSTRACT

Introduction: Melasma is a skin disorder characterized by acquired hyperpigmented macules, especially in the face, and more often affects women. Its incidence is unknown. Several treatment modalities are available to control the disorder. The MASI is a useful measure in the clinical evaluation of melasma, and MELASQoL is a tool to objectively evaluate the impact on patient's quality of life.

Objective: To evaluate the effectiveness of lactic acid peeling in patients with melasma, using MASI and MELASQoL.

Methods: 33 patients, predominantly of phototype IV, were treated with 85% lactic acid peeling (hydroalcoholic solution, pH = 3.5). Clinical results and patients' quality of life were evaluated using the Melasma Area and Severity Index - MELASQoL and the Melasma Quality of Life scale, respectively, before and after treatment.

Results: A significant reduction in both indices was verified after treatment, with an average decrease of seven points in the Severity Index. No correlation was observed between the changes in the two measures, meaning that clinical improvement did not always correspond with the patients' expectations regarding the treatment.

Conclusions: Lactic acid peeling is an effective, safe treatment method for melasma.

Keywords: melanosis; lactic acid; therapeutics; quality of life.

RESUMO

Introdução: *O melasma caracteriza-se por máculas hipercrômicas adquiridas, principalmente na face, que atingem frequentemente as mulheres, com verdadeira incidência desconhecida. O objetivo do tratamento é o controle da doença, e várias opções são disponíveis. O Índice de área e gravidade do melasma - MASI é medida útil na avaliação clínica do melasma, e o Melasma Quality of Life Scale - MELASQoL, instrumento capaz de verificar objetivamente o impacto na qualidade de vida dos pacientes.*

Objetivo: *avaliar, através do MASI e MELASQoL, o efeito do peeling de ácido láctico em pacientes portadores de melasma.*

Métodos: *33 pacientes portadoras de melasma, predominantemente do fototipo IV, foram submetidas a peelings seriados de ácido láctico 85% (solução hidroalcolica, pH=3,5). Foram realizadas avaliação clínica, através do MASI, e avaliação de impacto na qualidade de vida, através do MELASQoL, pré e pós-tratamento.*

Resultados: *observou-se redução significativa de ambos os índices após tratamento, tendo sido de sete pontos a queda média do MASI. Não foi observada correlação entre a variação do MASI e do MELASQoL, denotando que a melhora clínica nem sempre corresponde ao grau de expectativa das pacientes em relação ao tratamento.*

Conclusões: *o peeling de ácido láctico alia efetividade no tratamento do melasma com bom perfil de segurança.*

Palavras- chave: *melanose; ácido láctico; terapêutica; qualidade de vida.*

Authors:

Geraldo Magela Magalhães[1]
Maria de Fátima Melo Borges[2]
Patrícia Januzzi Vieira e Oliveira[3]
Daniela Rezende Neves[4]

[1] Professor of Dermatology, Faculdade de Ciências Médicas de Minas Gerais (FCMMG) – Belo Horizonte (MG), Brazil; Preceptor, Cosmiatry Outpatient Clinic, Santa Casa de Belo Horizonte (MG).
[2] Preceptor, Cosmiatry Outpatient Clinic, Santa Casa de Belo Horizonte (MG).
[3] Dermatologist Physician; Dermatology Specialist, Brazilian Society of Dermatology (SBD), Rio de Janeiro (RJ), Brazil.
[4] Dermatologist Physician; Dermatology Specialist, Brazilian Society of Dermatology (SBD).

Correspondence:

Geraldo Magela Magalhães, MD, PhD
Avenida do Contorno, 4747 sala 1709
30110 - 090 Belo Horizonte, MG, Brazil
E-mail: germagela@ig.com.br

Received on: 30/07/2010
Approved on: 10/09/2010

This study was conducted at the Cosmiatry Outpatient Clinic of Santa Casa de Belo Horizonte (MG), Brazil.

Conflict of interests: none
Financial support: none

INTRODUCTION

Melasma is an acquired pigmentary alteration characterized by hyperchromic macules mainly in the face, often occurring in women [1]. Its incidence rate is unknown [2,3].

Newcomer and colleagues (1961) were some of the first to observe an increased frequency of this type of hyperpigmentation, mainly in the face. The authors called attention to the influence of the sun in the trigger or recurrence of the disorder, to the absence of inflammation, to the characteristic distribution in areas of the face, to the unpredictability of its development, and to its refractory character to treatment [1].

Although the disorder's etiopathogeny remains inconclusive, several factors have been identified: solar radiation [1,2,4,5], pregnancy [2,5,6], cosmetics [1,5], endocrinologic disorders [7,8,9,10,11], and medicines – especially estrogen-progesterone replacement therapy and hormonal contraceptives [4,5,12]. The few studies that discuss the histopathological alterations found in affected skin [5,13] conclude that epidermal hyperpigmentation is probably caused by an increase in the number of melanocytes with great melanogenic activity, associated with a dermis that reveals evident signs of photodamage. In addition, Pathak et al. showed that the formation of melanin and immediate pigmentation can be induced as much by ultraviolet radiation (320 to 400 nm) as by visible light (400 to 650 nm), even in the absence of damage detectable by the cells [4]. Pathak then suggested that a specific type of melanocite, which brings about functional changes due to the combination of several activation factors, causes the lesions associated with melasma [5,13].

The Melasma Area and Severity Index (MASI), described in 1994 by Kimbrough-Green, is a useful measure in the clinical evaluation of melasma. Four areas of the face are analyzed in its calculation: frontal (F), right malar (RM), left malar (LM), and mentonian (M), corresponding to 30%, 30%, 30% and 10% of the total area of the face, respectively. Each area receives a score from 0 to 6, according to its extension. Severity is gauged by two factors: pigmentation (P) and homogeneity (H), on a scale from 0 to 4. The Index formula is: MASI =0.3 (PF + HF) AF + 0.3 (PRM + HRM) ARM +0.3 (PLM + HLM) ALM +0.1 (PM+ HM) AM. The MASI varies from 0 to 48 [14].

The Melasma Quality of Life Scale (MELASQoL) is a tool capable of objectively evaluating the quality of life of patients affected by melasma. It was developed by Balkrishnan et al. in 2003 [15]. In 2006, Cestari et al. translated the MELASQoL questionnaire into Brazilian Portuguese [16].

The objective of treating melasma is to control the disorder. Several treatments are available, such as depigmenting agents, chemical peels, microdermabrasion, lasers, and intense pulsed light [2]. Steiner et al., in a recent systemic review, showed that wide spectrum photoprotectors (UVA and UVB), combined with depigmenting creams, constitute the basis of the treatment of melasma. In addition, they observed chemical peels can contribute to a faster response, and noted that glycolic acid peels and Jessner's solution are the most frequently studied peels, and have positive results [17]. Some studies have recently demonstrated the effectiveness of lactic acid peels in the treatment of melasma [18,19].

The objective of this study was to evaluate the effects of an 85% lactic acid peel in patients with melasma. Specifically, we aimed to describe the clinical and epidemiological aspects, evaluate the therapeutic efficacy in the improvement of melasma, and assess the improvement in patient quality of life (gauged by the Brazilian Portuguese version of the MELASQoL) and clinical improvement (measured by the MASI).

METHODS

An open, prospective study was carried out in the Cosmiatric Outpatient Clinic of the Dermatologic Clinic of Santa Casa de Belo Horizonte, in the Brazilian State of Minas Gerais, in outpatients with melasma (n = 33), from April to December 2009. The study was approved by the Committee of Research Ethics and all participants signed a term of free and informed consent.

The study included women with facial melasma over age 18 with Fitzpatrick scale phototypes I to V. The exclusion criteria were: women who were pregnant, lactating, or planning to become pregnant in the following 3 months; women with other cutaneous disorders in the face; known allergy to lactic acid or to the vehicle; use of topical medications (retinoids, hydroquinone, glycolic acid etc), phototherapy or artificial tanning less than 2 weeks before the assessment date; treatment with lasers, intense pulsed light, dermabrasion or peels less than 3 months prior to the assessment date; use of oral corticotherapy less than 1 month before the assessment date; use of systemic retinoid, cyclosporin, interferon or methotrexate less than 4 months prior to the assessment date; use of photoallergic, phototoxic or photosensitizer medications less than 1 month before the assessment date; and the use of hormone replacement therapy less than 1 month before the assessment date (except in cases of continuous use for more than 3 months).

Lactic acid peels were performed (85%; pH 3.5 in hydroalcoholic solution) in weeks 0, 2, 4, 6, 8 using the following technique: the product was applied on the melasma area of the skin for 2 to 3 minutes until erythema was observed. If erythema did not occur, the product was reapplied. The product was removed after 10 minutes, and the skin was washed with water. The only complementary treatment allowed was the use of sunscreens. Patients were administered the MASI and MELASQoL in weeks 0 and 10. Two patients did not undergo the final evaluation.

In the descriptive analysis of the nominal or categorical variables, tables of frequency distribution were prepared. Measures of central tendency (mean and median) and dispersion (standard deviation, minimum and maximum) were calculated for the continuous variables. The Paired T-test was used to compare the values of the MASI and MELASQoL scales before and after treatment. A variable representing the difference between the initial and final values of the two scales was created

in order to quantify the magnitude of the reduction in scores after treatment. The correlation between these scores of difference between the two scales was also evaluated (using the Pearson coefficient), to verify whether a large reduction in MASI scores also reflected a large reduction in MELASQoL scores, and vice versa. In all analyses a 5% significance level was considered. The statistical software used was SPSS 15.0.

RESULTS

A large majority (81.8%) of the studied patients lived in urban areas, 60.6% had skin phototype IV and 78.8% had never smoked (Table 1). The mean age was approximately 40 (range 30-59 years) and most were classified as phototype IV (60.6%). Of the 33 analyzed patients, 7 (21.2%) had previous skin disorders – in two cases (6.1%), vitiligo – and 3 (9.1%) had active skin disorders including acne, vitiligo and cold urticaria (Table 2). According to Table 3, 39.4% of the studied patients had a systemic disorder; hypothyroidism was the most frequent, occurring in 4 patients (12.1%). The menarcheal mean and median ages were 13 years old. Menopause began, on average, at the age of 43 (range 36-53 years).

The use of systemic medications was verified in 72.7% of the sample; oral contraceptives were the most frequent (36.4%). Only 15.2% of the studied patients reported a relationship between the use of medication and the appearance of melasma (Table 4). Table 5 shows that 21.2% of the studied women used oral contraceptives at the time of the evaluation. The mean time of use was 114.5 months (around 9.5 years), with a range of 3 months to 20 years. For 11 patients (34.4%), the macules first appeared or worsened during pregnancy, and only 1 patient (3%) did not use sunscreen (Table 6). The average number of daily applications of sunscreen was approximately 2 (range 0-5).

Mean MASI scores before the treatment were higher among women with phototypes IV and V, who had no history of contraceptive use, and for whom melasma had not started during pregnancy (Table 7). These differences were not statistically significant ($p > 0.05$). It is worth noting that phototypes II/III and IV/V were grouped together due to the

Table 1 - Epidemiological profile of study patients – origin, phototype, smoking and age (n=33)

	Frequency	%
Origin		
Rural	6	18,2
Urban	27	81,8
Phototype		
II	2	6,1
III	6	18,2
IV	20	60,6
V	5	15,2
Smoking		
Former smoker	7	21,2
Never smoked	26	78,8
Age		
Mean	43,9	
Median	40	
Standard deviation	9,5	
Minimum	30	
Maximum	59	

Table 2 - Epidemiological profile of study patients – previous and active skin disorders, systemic disorders (n=33)

	Frequency	%
Previous skin disorders	7	21,2
Which?		
Contact dermatitis – plastic	1	3,0
Contact dermatitis – hydroquinone, nickel	1	3,0
Pruritus	1	3,0
Corporis, Onichomycosis	1	3,0
Cold urticaria	1	3,0
Vitiligo	2	6,1
Active skin disorders	3	9,1
Which?		
Acne	1	3,0
Vitiligo	1	3,0
Cold urticaria	1	3,0

Table 3 - Epidemiological profile of study patients – systemic disorders, age at menarche and menopause (n=33)

	Frequency	%
Systemic disorders	13	39,4
Which?		
Colloid goiter	1	3
Depression	2	6,1
Dyslipidemia	1	3
Diabetes mellitus	1	3
Arterial hypertension	2	6,1
Hypothyroidism	4	12,1
Nephrolithiasis, gastritis	1	3
Sinusitis	1	3
Menarche		
Mean	13,1	
Median	13	
Standard deviation	2,1	
Minimum	10	
Maximum	18	
Menopause		
Mean	43,1	
Median	42	
Standard deviation	5,8	
Minimum	36	
Maximum	53	

Table 4 - Epidemiological profile of study patients – medication use history and relationship between medication use and appearance/beginning of melasma (n=33)

	Frequency	%
Systemic medication use history	24	72,7
Which?		
Injectable contraceptive	1	3
Injectable contraceptive, levothyroxine	1	3
Oral contraceptive	12	36,4
Oral contraceptive, captopril	1	3
Oral contraceptive, levothyroxine	2	6,1
Oral contraceptive, anafranil	1	3
Atenolol, hydrochlorothiazide	1	3
Hygroton	1	3
Metformin	1	3
Sibutramine, oxybutynin	1	3
levothyroxine, injectable contraceptive	1	3
Hormone replacement therapy, clonazepam, amitriptyline	1	3
Relationship between medication use and the beginning of melasma		
Yes	5	15,2
No	28	84,8

Table 5 - Epidemiological profile of study patients – contraceptive use and length of use (n=33)

	Frequency	%
Contraceptive use		
Yes	7	21,2
No	26	78,8
Length of use (in months)		
Mean	114,5	
Median	108	
Standard deviation	99,1	
Minimum	3	
Maximum	240	

Table 6: Epidemiological profile of study patients – relationship between macules with pregnancy and the use of sunscreen (n=33)

	Frequency	%
Macules appeared or worsened during pregnancy*		
Yes	11	34,4
No	21	65,6
Use of sunscreen		
Yes	32	97
No	1	3
Number of daily applications of sunscreen		
Mean	2,2	
Median	2	
Standard deviation	1	
Minimum	0	
Maximum	5	

* Question does not apply to one patient (3%), who has never been pregnant

Table 7: Association between MASI scores before treatment and phototype, previous and current contraceptive use, and beginning of the melasma during pregnancy

	MASI beginning		
	Mean	Standard deviation	p-value*
Phototype			
II and III	12,3	7,2	0,210
IV and V	15,9	6,8	
Previous history of contraceptive use			
No	15,4	7,1	0,803
Yes	14,8	7,1	
Current contraceptive use			
No	16	7,3	0,125
Yes	11,4	4,6	
Macules appeared or worsened during pregnancy			
No	15, 5	7,3	
Yes	14,3	6,8	0,653

*Student T-test

reduced sample size in some groups. In addition, it was not possible to analyze the variable use of sunscreen, since all but one patient used sunscreen.

There was a significant reduction in MASI and MELASQoL scores after treatment ($p < 0.05$) (Table 8). Mean MASI mean scores decreased from 15 before treatment to 8 after treatment; MELASQoL mean scores declined from 36.3 to 31.7. There was a mean difference of 7 points in MASI scores before and after treatment (range -1 to 19) (Table 9). Regarding the MELASQoL scale, the mean increase in points after treatment was approximately 5 (range 20-27). A large reduction in MASI score did not correlate significantly with a large reduction in MELASQoL score ($p = 0.925$) (Graph 1.)

There was no significant correlation between MASI and MELASQoL scores, either before or after treatment (Table 10). The correlation coefficients were low (0.074 before and 0.130 after treatment) and were not statistically significant ($p > 0.05$). The percentage of improvement in the MASI scale after

Table 8: Comparison of MASI and MELASQoL scores before and after treatment

	MASI beginning	MASI final	MELASQOL beginning	MELASQOL final
N	33	31	33	31
Mean	15	8	36,3	31,7
Median	14,9	7,3	36	32
Standard deviation	7	4,7	13,8	14
Minimum	4,2	0,6	7	7
Maximum	33,6	16,2	60	55
p-value*	**<0,001**		**0,031**	

* Teste t-pareado

treatment was 96.8%, and 64.5% for the MELASQoL scale (Table 11).

Two patients did not complete the study, due to absence in the follow-up sessions. Few adverse effects, such as transient erythema and light edema were observed, immediately after the peeling.

DISCUSSION

The study's population mean age was 40 with the predominance of phototype IV; 39.4% of the studied patients had some systemic disorder, with hypothyroidism being the most frequent (12.1%). The study population's phototype, age, systemic disorders and medication use were consistent with the literature regarding the etiopathogenic factors of melasma.

Mean MASI scores before treatment were higher in patients with phototypes IV and V, with no history of contraceptive use and in whom melasma had not started during pregnancy. We emphasized that in all cases those differences were not statistically significant ($p > 0.05$).

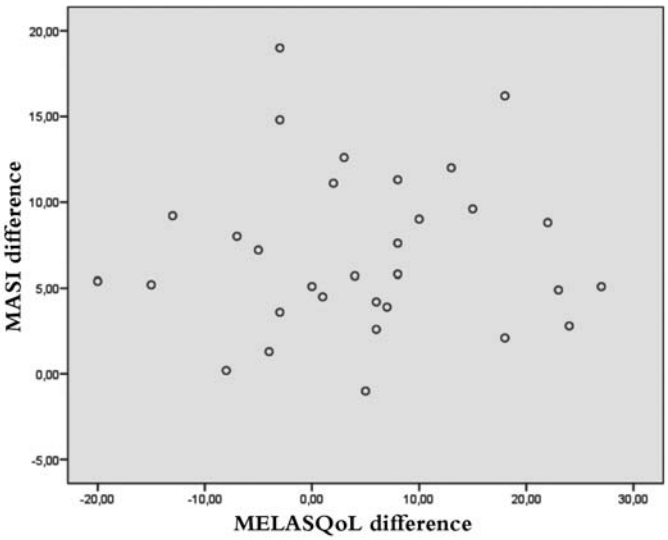
A significant reduction in MASI scores was observed after five sessions of lactic acid peel, applied exclusively as a treatment for melasma. In this study, the average reduction in MASI scores was 7 points, corresponding to findings by other authors in other population groups [18]. MELASQoL scores also indicated a significant improvement in patients' quality of life.

No correlation between reductions in MASI and MELASQoL scores was observed, illustrating that clinical improvements do not always translate into improvements in patients' quality of life. Likewise, when evaluated before and after treatment, no significant correlation between MASI and MELASQoL scores was found ($p > 0.05$). This discovery suggests that the severity of melasma is not associated with a worse quality of life.

Table 9: Difference between MASI and MELASQoL scores before and after treatment

	Difference MASI	Difference MELASQoL
N	31	31
Mean	7	4,7
Median	5,7	5
Standard deviation	4,7	11,7
Minimum	-1	-20
Maximum	19	27

Graph 1: Dispersion diagram comparing the difference between MASI and MELASQoL scores



Chemical peels can contribute to the treatment of melasma [17]. In a systemic review, Bagatin et al. observed that there are no doubts about the benefit of chemical peels in the treatment of several dermatoses, including melasma. However, they highlight the fact that this conclusion is based more on practical experience than on well-controlled and replicable studies [20].

Glycolic acid is the main alpha-hydroxy acid used as an exfoliating agent in the treatment of melasma. Some studies concluded that alpha-hydroxy acids, combined with topical treatments, produced better and faster results [21,22]. Others, however, did not succeed in reproducing positive results [23,24]. One possible explanation for the conflicting results is the difference in the methodological quality of the studies.

Some studies have compared different peels in the treatment of melasma: Jessner's solution and salicylic acid [25], Jessner's solution and glycolic acid [26], Jessner's solution and lactic acid [19], and glycolic acid and retinoic acid [27]. All studies demonstrated the efficacy of the products in the improvement

Table 10: Analysis of the correlation between MASI and MELASQoL scores before and after treatment

	Coeficiente de correlação*	Valor-p
MASI X MELASQoL before treatment	0,074	0,683
MASI X MELASQoL after treatment	0,130	0,484

* Pearson correlation coefficient

Table 11: Percentage improvement according to differences in MASI and MELASQoL scores

	MASI	MELASQoL
Worsening	1 (3,2%)	10 (32,3%)
Constant	0	1 (3,2%)
Improvement	30 (96,8%)	20 (64,5%)

of melasma; none reported significant differences among the agents. Some recent studies have shown that lactic acid presents benefits as an isolated peeling agent in the treatment of melasma, [18,19] similar to the results of the present study.

This peel was also found to be safe: there was an almost total absence of adverse events, even in groups with a majority of phototype IV (60.9%). The only events verified were light and transient erythema and edema immediately after the procedure. It was not necessary to interrupt any treatment due to adverse effects.

CONCLUSION

Lactic acid peels are effective and safe in the treatment of melasma, as a monotherapy. This open, uncontrolled study has its limitations. Comparative studies, controlled for other superficial peel techniques, are necessary to further evaluate this treatment modality. ●

ACKNOWLEDGEMENT

We would like to express our gratitude to Ms. Karina de Sá Pedras, pharmacist in charge at the Amphora Farmácia de Manipulação, for the dispensing of the 85% lactic acid peel.

REFERÊNCES

1. Newcomer VD, Lindberg MC, Sternberg TH. A melanosis of the face ("chloasma"). Arch Dermatol. 1961;83(2):284-299.
2. Grimes PE. Melasma. Etiologic and therapeutic considerations. Arch Dermatol. 1995;131(12):1453-7.
3. Halder RN, Grimes PE, McLaurin CI, kress MA, kennery JAJ. Incidence of common dermatoses in a predominantly black dermatologic practice. Cutis. 1983;32(4):388-90.
4. Pathak MA, Riley FC, Fitzpatrick TB. Melanogenesis in human skin following exposure to long-wave ultraviolet and visible light. J Invest Dermatol. 1962;39(5):435-3.
5. Sanchez NP, Pathak MA, Sato S, Fitzpatrick TB, Sanchez JL, Mihm Jr MC. Melasma: a clinical, light microscopic, ultrastructural, and immunofluorescence study. J Am Acad Dermatol. 1981;4(6):698-710.
6. Muzaffar F, Hussain I, Haroon TS. Physiologic skin changes during pregnancy: a study of 140 cases. Int J Dermatol. 1998;37(6):429-31.
7. Grando SA. Physiology of endocrine skin interrelations. J Am Acad Dermatol. 1993;28(6):981-92.
8. Perez M, Sanchez JL, Aguilo F. Endocrinologic profile of patients with idiopathic melasma. J Invest Dermatol. 1983;81(6):543-45.
9. Sacre RC, Fernandes NC, Vaisman M, Tendrich M. Melasma idiopático: avaliação das funcões tireóidiana, prolactínica e gonadal feminina. An bras Dermatol.1996;71(3):195-8.
10. Hassan I, Kaur I, Sialy R, Dash RJ. Hormonal milieu in the maintenance of melasma in fertile women. J Dermatol. 1998;25(8):510-2.
11. Lutfi RJ, Fridmanis M, Misiunas AL, Pafume O, Gonzalez EA, Villemur JA, et al. Association of melasma with thyroid autoimmunity and other thyroidal abnormalities and their relationship to the origin of melasma. J Clin Endocrinol Metab. 1985;61(1):28-31.
12. Smith AG, Shuster S, Thody AJ, Peberdy M. Chloasma, oral contraceptives, and plasma immunoreactive beta-melanocyte-stimulating hormone. J Invest Dermatol. 1977;68(4):169-70.
13. Kang WH, Yoon KH, Lee ES, Kim J, Lee KB, Yim H, et al. Melasma: histopathological characteristics in 56 Korean patients. Br J Dermatol. 2002;146(2):228-37.
14. Kimbrough-Green CK, Griffiths CE, Finkel LJ, Hamilton TA, Bulengo-Ransby SM, Ellis CN, Voorhees JJ. Topical retinoic acid (tretinoin) for melasma in black patients. A vehicle-controlled clinical trial. Arch Dermatol. 1994;130(6):727-33.
15. Balkrishnan R, McMichael AJ, Camacho FT, Saltzberg F, Housman TS, Grummer S, et al. Developmente and validation of health-related quality of life instrument for women with melasma. Br J Dermatol. 2003;149(3):572-7.
16. Cestari TF, Balkrishnann R, Weber MB, Prati C, Menegon DB, Mazzoli NH, et al. Translation and cultural adaptation to Portuguese of a quality of life questionnaire for patients with melasma. Med Cut Iber Lat Am. 2006;34(6):270-4.
17. Steiner D, Feola C, Bialeski N, Silva FAM. Tratamento do Melasma: revisão sistêmica. Surg Cosmet Dermatol.2009; 1(1):87-94.
18. Sharque KE, Al-Tikreety MM, Al-Mashhadani SA. Lactic Acid as a New Therapeutic Peeling Agent in Melasma. Dermatol Surg. 2005;31(2):149-54.
19. Sharque KE, Al-Tikreety MM, Al-Mashhadani SA. Lactic Acid Chemical Peels as a New Therapeutic Modality in Melasma in Comparison to Jessner's Solution Chemical Peels. *Dermatol Surg* 2006;32:1429-1436.
20. Bagatin E, Hassun K, Talarico S. Revisão sistêmica sobre peelings químicos. *Surg & cosmetic dermat* 2009; 1:37-46.
21. Sarkar R, Kaur C, Bhalla M et al. The combination of glycolic acid peels with a topical regimen in the treatment of melasma in dark-skinned patients: a comparative study. Dermatol Surg 2002;28(9):828-832.
22. Erbil H, Sezer E, Tatan B et al. Efficacy and safety of serial glycolic acid peels and a topical regimen in the treatment of recalcitrant melasma. *J Dermatol* 2007; 34(1):25-30.
23. Lim JT, Tham SN. Glycolic acid peels in the treatment of melasma among Asian women. *Dermatol Surg* 1997;23(3):177-179.
24. Hurley ME, Guevara IL, Gonzalez RM *et al*. Efficacy of glycolic acid peels in the treatment of melasma. Arch Dermatol 2002; 138(12):1578-1582.
25. Ejaz A, Raza N, Iftikhar N et al. Comparison of 30% salicylic acid with Jessner's solution for superficial chemical peeling in epidermal melasma. *J Coll Physicians Surg Pak* 2008;18(4):2005-2008.
26. Lawrence N, Cox SE, Brody HJ. Treatment of melasma with Jessner's solution versus glycolic acid: a comparison of clinical efficacy and evaluation of the predictive ability of Wood's lamp examination. J Am Acad Dermatol. 1997;36(4):589-93.
27. Khunger N, Sarkar R, Jain RK. Tretinoin peels versus glycolic acid peels in the treatment of Melasma in dark-skinned patients. Dermatol Surg. 2004;30(5):756-60.