

Facial Rejuvenation with Hybrid Laser Treatment

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Abstract

A laser rejuvenation depending on the wavelength can treat wrinkles, dilated pores, dry skin, brown spots, sagging, vascular lesions, and texture but sometimes we need to make many sessions to see a clear benefit before and after or we have a very long recovery time. By applying different cosmetics after a resurfacing, we can achieve quicker results with an integral rapprochement. The purpose of this study is to use a non-focused which creates acoustic pressure above the skin for trans-epidermal delivery of cosmeceutical products to prove better and quicker results after one laser treatment. A random sampling of 60 people was divided into 6 groups to try different products and they were evaluated with a computer skin analysis, pictures before and after, an ultrasound, a satisfaction survey, and biopsies before the procedure and one month later. The rejuvenation agents used in the present study were retinoic acid, vitamin C, hydroquinone, hyaluronic acid, tranexamic acid and a combination of these cosmeceuticals.

1. Introduction

Aging is the result of the accumulation of a wide variety of molecular and cellular damage over time, leading to a gradual decline. Even before they appear on the outside, they are already affecting the skin on the inside. It has been seen that the aging starts around the 20s, and it depends on the genes who determine how a person will age naturally, however, up to 50% of the aging process could be due to the environment or by the care that a person has internal or external of the body and therefore the skin. The secret is staying on top of the skincare habits, lifestyle and how the fine lines and wrinkles are treated.

One of the main problems in aesthetic medicine is the topical drug delivery because, as we know, the cutaneous bioavailability when drugs are applied topically is very low with only 1% - 5% being absorbed into the skin [1] even though there are three permeability pathways through the epidermis: 1) Intracellular, by which the most lipophilic substances are absorbed, through the desmosomes of the intercellular spaces; 2) Transcellular, through the aqueous pores of keratinocytes and 3) Trans adnexal, which takes place through the spaces of the hair follicles mainly and to a lesser extent the acrosyngia [2].

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Many of the cosmeceuticals used for rejuvenation regularly do not penetrate the epidermis, to be more specific, the stratum corneum; which is the barrier of the skin [3-6], because their molecules are too big to penetrate and they need to be injected. The purpose of this study is to use the hybrid laser, which counts with an ultrasound to allow a deeper penetration of different substances through trans epidermal route and to prove better results by using the new technology for drug delivery.

Nowadays, there are very few studies using the combination of fractional non-ablative 1570 nm and the ablative 10,600 nm lasers for skin rejuvenation [7], and either enough datum on the use of different rejuvenation agents (cosmeceuticals) applied after the laser treatment, in order to have better results. The rejuvenation agents used in the present study were retinoic acid, vitamin C, hydroquinone, hyaluronic acid, tranexamic acid and a combination of these cosmeceuticals. Cosmeceuticals are cosmetic formulations containing bioactive ingredients known for their medical benefits and the global cosmeceuticals market size is expected to increase 56.71% from 2022 to 2029, that means from 54.27 billion in 2022 to 96.23 billion in 2029 [25].

Lindsay et al [5], mentioned that the laser therapy is the ablative process that has the ability to destroy the stratum corneum, epidermal and dermal layers of the skin, resulting in the increased penetration of topically applied molecules. Therefore, the most studied types of laser devices are the erbium: yttrium-aluminum-garnet (Er: YAG) laser with a wavelength of 2,940 nm and the carbon dioxide (CO₂) laser with a wavelength of 10,600 nm, regarding laser assisted drug delivery.

The Er: YAG laser is strongly absorbed by water in the epidermis [8] and the ablation effect has minimal penetration depth and minimal heat generation and therefore minimal thermal damage [9-11]. On the other hand, the CO₂ laser produces a higher thermal effect helping an increase in the stratum corneum permeability [9] because of the microthermal zones formed. A schematic of an ablative fractionated laser device allowing topical drug penetration by the creation of microthermal zones (MTZs), is shown below [5]:

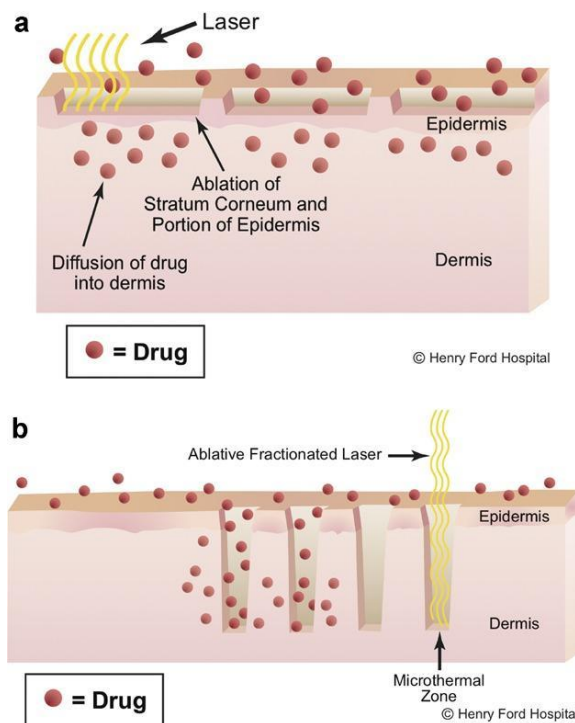


FIG. 1. Schema of an ablative fractionated laser device allowing topical drug penetration.

It is important to mention that these MTZs serve as access channels, allowing the drug to penetrate the barrier of the stratum corneum. The modification of laser parameters can allow precise depth of ablation limited to the stratum corneum and dermis (a) or deeper ablation into the dermis (b) [5].

A study of photodynamic therapy (PDT) using in vivo human skin mentioned that when 5- aminolaevulinic acid (ALA) and methyl amino levulinate are applied on superficial nonmelanoma skin cancers treatment, they do not penetrate deeper than 1mm. However, the use of an Er: YAG permits to increase the penetration of the ALA by 13.7 at an energy of 1 and 4 J/cm² for continuous and fractional ablation respectively allowing a pore depth of 12.5 ± 7.8 nm localized to the stratum corneum. As a result, the Er: YAG laser has permitted an increment in the flux of ALA from 27 to 124-fold in nude mouse skin and 3 to 260-fold in porcine skin. They used a fluence of 2 or 3 J/cm² which corresponded penetration depths of 8 to 12 nm, respectively. Finally, it is important to mention that the required dose of topical applied agents was 20% less [12].

Brunsting and Sheard, mentioned that skin colorization is characterized by a limited number of colorants, or “chromophores”, within the layers of skin. Melanin and hemoglobin are the primary colorants, when they are in the skin in high concentrations, they are often markers for various skin diseases and disturb the skin tone. In laser Technology it is important because the darker the skin, the lower fluency has to be used. In Latin America, the most frequent skin types are IV and V.

Resident cells of the dermis, such as fibroblasts and mast cells, also play an important role in skin melanogenesis. This kind of pigmentation is induced by the interaction of the peptide derived from proopiomelanocortin (pomc) and its receptor (mc1r) [13].

Among the specific activities carried out by the Hyaluronic acid are the migration of fibroblasts and fibrogenesis, the regulation of the level of proliferation and thickness of the epidermis, as well as the proliferation of keratinocytes [14]. Then, by applying hyaluronic acid, the fibroblast is activated and with this, the melanogenesis is better controlled [15].

The pigmentation improves with the different active ingredients due to their mechanism of action. It is important to remember that the ascorbic acid converts dopaquinone into levodopa (L-DOPA), preventing the formation of melanin. The retinol suppresses tyrosinase activity, and decreases the number of melanosomes, and inhibits melanosome transfer. On the other hand, the azelaic acid contained in the tranexamic acid used in this study inhibits the tyrosinase, has an antiproliferative and a cytotoxic effect on melanocytes but not on the surrounding cells [16].

It is important to remember that one of the main factors of aging is photodamage. UV rays (UVB and UVA) generate free radicals that increase collagenase activity (through the epidermal growth factor receptor (EGFR), increasing collagen fragmentation and decreasing transforming growth factor (TGF- β), which in turn decreases the formation of collagen fibers [17,18]. This has been shown histologically in vivo with increased levels of collagenase messenger RNA (mRNA) and the increased activity after UV exposure and decreased the expression of the procollagen gene after this same exposure. Thus, photodamage leads to permanent photoaging characterized by collagen deficiency, excess of collagenase and micro and macro scarring and with the time the skin becomes thin, fragile and wrinkles are visible.

Immunohistochemistry has shown an increase in the protein collagenase in aged skin in vivo, increased activity, increased fragmented collagen and decreased TGF- β at the mRNA level and decreased procollagen type I, in skin of patients older than 80 years compared to controls aged 18 - 30 years old [17,18]. The final pathway of these mechanisms leads to a decrease in the mechanical tension of the skin, which in turn leads to a reduction in TGF- β , and increase in collagenase and decrease in the synthesis of the procollagen, a self-perpetuating destructive cycle.

Antioxidants counteract cellular oxidation and free radical damage in multiple ways. The electron donors (primary antioxidants) are ascorbic acid, resveratrol, tea polyphenols, vitamin E, glutathione, silybin, ferulic acid, idebenone, Arabica coffee extract (*Coffea arabica*).

Among the metal ion binders (secondary antioxidants) are ascorbic acid, silybin, caffeine, resveratrol; and there are also those that facilitate the action of other antioxidants, such as ascorbic acid, vitamin E and glutathione. A synergistic action has been seen between the use of sunscreens and antioxidants as protectors of collagen and the extracellular matrix, that is one of the most important reasons to use sunscreen and to have the appropriate skin care routine [18-25].

It must be remembered that retinoids markedly increase the production of TGF- β and procollagen I, and also decrease collagenase production with a statistically significant difference with respect to the vehicle. It has been shown that they induce epidermal hyperplasia and an increase in Ki67, an index of proliferation in keratinocytes. Besides, they also increase collagen I y III mRNA, increase elastin, glycosaminoglycans, decrease elastase levels and produce desquamation with increased cell turnover.

It is important to mention that retinoids have a positive effect not only on extrinsic aging but also on intrinsic aging, and that is why they reduce signs of aging such as wrinkles, loss of skin elasticity and therefore texture.

Dilated pores can occur in all skin types, but are more characteristic of oily, acne-prone skin. As in this type of skin an excess of sebum is produced, the walls of the pilosebaceous follicle are deformed and there is a deficient skin renewal with an abnormal proliferation of the keratinocytes [26].

As we know, differences in skin pigmentation do not result from differences in the number of melanocytes in the skin, as one might assume, but from differences in the melanogenic activity, the type of melanin produced in melanosomes and the size, number and packaging of melanosomes, with melanin content of melanosomes ranging from 17.9% to 72.3% [27-32].

2. Materials and Methods

2.1 Laser treatment

The Alma Hybrid TM system is the first and unique device of its kind to bring together three powerful energies. It is a dual sequential application of fractional non-ablative 1570 nm and the ablative CO₂ 10,600 nm lasers plus the impact, a low frequency, non-focused ultrasound which creates acoustic pressure above the skin for trans-epidermal delivery of cosmeceutical products.

The combination of a wide range of ablative, non-ablative and thermal treatments allows the power of the three core energies to create a unique synergistic effect.

On one hand the CO₂ laser is the optimal blend of ablative, coagulative and thermal effect for efficient, highly-precise focus or fractional laser treatments. Besides, the fractional non ablative 1570 nm is a powerful non ablative modulated fiber laser which creates a thermal effect that promotes new dermis synthesis while leaving the epidermis intact.

IMPACT for Trans epidermal Delivery (TED) is a patented ultrasound technology, which overcomes the forces of intra cellular fluid produced by the skin to deliver pharmaceuticals and cosmeceuticals trans-epidermally, through the micro-channels created by the CO₂ laser, penetrating deep into the skin layers to achieve enhanced results.

The ProScan applicator was used in all the study patients in a ratio 1:1, in other words the grid was equivalent to 50% of CO₂ and 50% of 1570 nm. Depending on the skin phototype from the patients (III-V) a total energy of 10 to 12 mj was used in the CO₂ and from 38 to 40 mj with the 1570 nm with the highest density available. And right after the IMPACT was used with the different cosmeceuticals depending on the group that was selected based on their computer skin analysis.

All the patients underwent 60 minutes of occlusive topical anesthesia with 25 mg/g of lidocaine and 25 mg/g of procaine, and we prescribed home treatment based on retinol 0.5 % and tranexamic acid 2% for the night and sunscreen FPS+ 50 every four hours during the day.

2.2 VISIA

The VISIA (Canfield Scientific INC., United States) is a computerized skin analysis system, that has a capture booth that rotates smoothly around the face of the person and greatly simplify the imaging process while providing greater comfort for the client, because the guides of front position and chin, and cockpit rotary ensures the capture of shape images controlled, easily and reproducible.

In addition, an updated software allows faster image capture with automatic skin type classification for processing and analysis. Visia shows a quantitative analysis for eight skin characteristics: spots, wrinkles, texture, pores, UV spots, brown spots, red areas, porphyrins and relative age. It will give a percentage value in all these skin characteristics compared with other people from the same age, skin type and gender. The higher the percentages, the better is the qualification of the analysis.

Hereunder, there is a description of all the aspects from the skin that are analyzed with the VISIA scanner:

1. Spots are considered as the pigmentations on the surface of the skin. They are typically brown or red skin lesions, including freckles, acne scars, hyperpigmentation, and vascular lesions, distinguishable by their distinct color and contrast from the background skin tone.
2. Wrinkles are furrows or folds in the skin and they are associated with a decrease in skin elasticity and increase in occurrence as a result of sun exposure

3. Texture is concerned with the smoothness of the skin.
4. Pores are circular spaces on the surface of the skin of the sweat glands.
5. UV spots manifest when melanin is accumulated below the surface of the skin as a result from sun damage. Since UV Spots may not be visible under normal lighting conditions, they are photographed with ultraviolet illumination. The selective absorption of the UV light by the epidermal melanin enhances its display and detection by VISIA.
6. Canfield RBX's unique Technology using cross-polarized imaging allows to visualize the accumulation of Melanin, which is produced by melanocytes in the bottom layer of the epidermis. VISIA helps us to see brown spots that are lesions that represent hyperpigmentation, freckles and melasma.

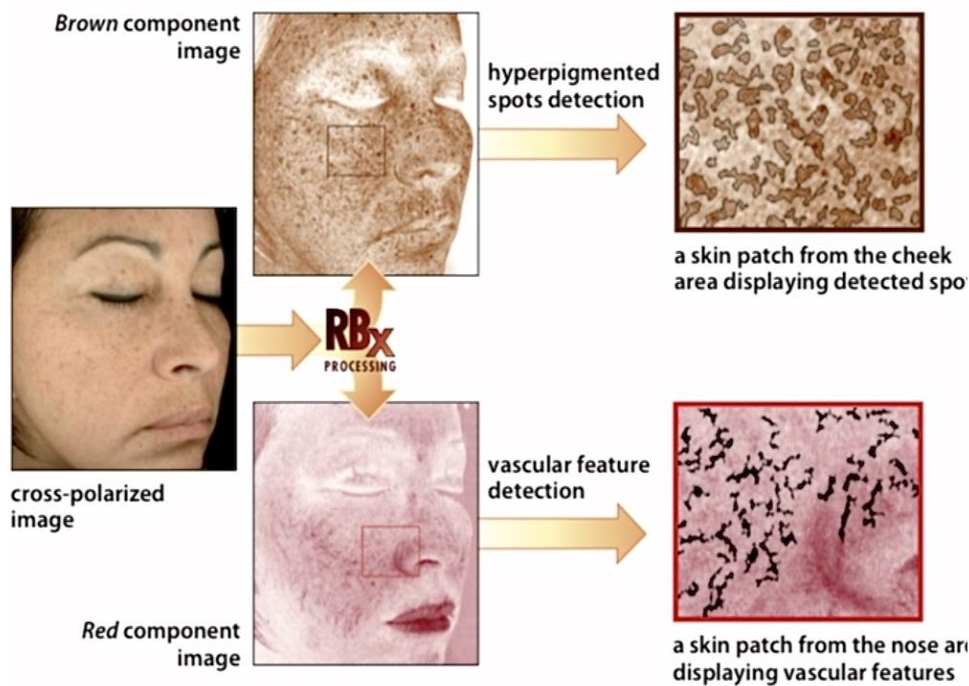


FIG. 2 Schematic flow of RBX analysis and typical Red & Brown component images: detected hyperpigmented spots and vascular features are displayed in certain areas.

7. Using RBX (Red/Brown/X) Technology, the images of red areas show vascular lesions such as acne, inflammation, rosacea and telangiectasias. Blood vessels and hemoglobin contained in the papillary dermis, a sub-layer of skin, give these structures their red color.
8. Porphyrins are excreted by bacteria that nest in acne pores. They fluoresce in UV light and exhibit circular white spot characteristics. Porphyrins are photographed with ultraviolet illumination
9. Finally, True Skin Age calculates the relative age of the patient's skin, depending on your general skin condition.

All the patients who did the study were taken at least two times the scanner, once right before the laser and another one a month after the treatment.

2.3 LOGIQ e (GE Healthcare)

GE LOGIQ e, is an ultrasound machine with 15” high-resolution LCD display and laptop design. The tissue differentiation system helps you detect subtle anatomical changes, minute amounts of fluid and small structures. This is achieved by combining the imaging technology and the ultrahigh frequency transducer which along with a 20 percent improvement in contrast ratio, helps to clarify differences in anatomical detail.

This ultrasound comes with specific software and transducers that help you see needles and also it allows you to see the different layers from the skin, which was very useful for the study. One ultrasound was made in every patient before the laser and one month after the laser focusing on the dermis layer from the skin to be able to analyze the stimulation from collagen fibers and the thickness of the layer after the laser session.

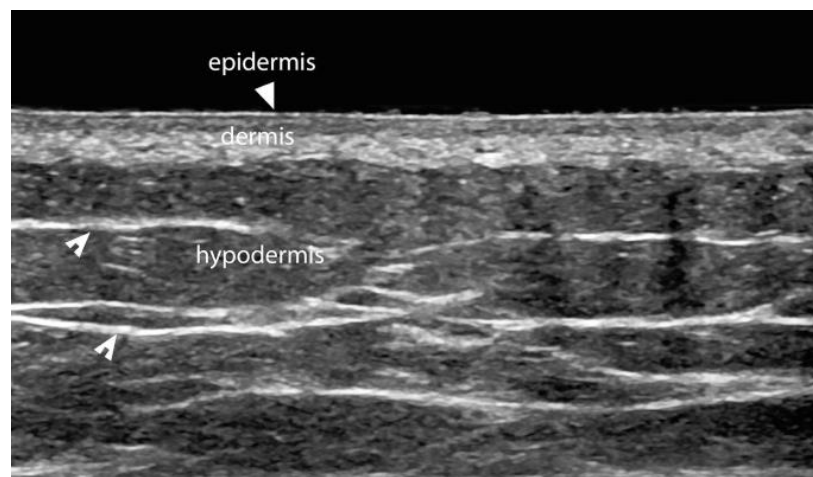


FIG. 3. Schema from the different layers from the skin viewed from a normal ultrasound.

2.4 Biopsy

In a skin biopsy, cells are removed from the surface of the face. In this study most of the patients underwent two mm punch biopsies, one procedure right before the laser and the second one after one month from the treatment. The biopsies were made in the preauricular area for aesthetics reasons and convenience of the patient with anesthesia (Lidocaine 2%) and a suture of Nylon 4-0 was used in all the cases. After the procedure was done the samples were properly collected in 10% of formol and they were sent right away to the pathologist. It was tried to make the biopsies in all our patients, but because of the complicity of the procedure and the scar, it was not possible to complete all the biopsies.

2.5 Pictures

Photo standardization is a challenge faced by aesthetic practitioners but with the benefit of a standardized 3D camera this job becomes easier. A special camera is indispensable for achieving the level of image quality and reproducibility that ensure consistent and accurate clinical assessments. A Nikon camera, model Quantify Care, Life Viz infinity was used, the pictures were taken before the treatment and one month after the treatment.

2.6 Rejuvenation agents

After perfectly cleaning the skin of the patients, taking the pictures, the skin analysis (VISIA) and signing the informed consent, lidocaine cream was applied for 60 minutes before the biopsy and the laser treatment.

The laser was used giving a sequential irradiation of the two wavelengths 10,600 and 1,570 nm with the biggest spot available and the small one for complicated areas and a high density. Afterwards one of the 6 rejuvenation agents were applied for each of the 6 different groups.

The rejuvenation agents for the treatment were the following:

- **Hyaluronic acid:**
Hyaluronic acid • Vitamin B5 • Thermal water
- **Vitamin C 10%**
Vitamin C 10% • Biopeptides
- **Hydroquinone 4%**
Fluocinolone • Hydroquinone 4% • Tretinoin
- **Retinol 0.5%**
Retinol 0.5% • Niacinamida • Salicylic acid
- **Tranexemic acid**
Azelaic Acid • Tranexamic Acid • Niacinamida

The mixed group was treated with Vitamin C 10%, Hyaluronic Acid and Tranexamic acid. Hydroquinone was not used because of the high frequency of secondary effects present with this product.

Rejuvenation agent	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6
Mixed						
Hyaluronic acid	X	X				
Vitamin C	X		X			
Hydroquinone				X		
Retinol					X	
Tranexemic acid	X					X

FIG. 4. Chart from the different rejuvenation agents used after the laser treatment.

2.7 Patient satisfaction survey

A 16th questions survey was carried out with the patients, the questions are in the following table:

	Question
1	How do you rate the care received during treatment (from start to finish)?
2	How do you rate the quality of the treatment received?
3	Was the treatment painful?
4	How many days did it take for your recovery?
5	How many days did the redness last?
6	How many days did the skin peeling last?
7	How many days did the scabs last on your skin?
8	Regarding the treatment at home (creams) that was indicated to you, did you like it?
9	Regarding the treatment at home (creams) that was indicated, have you felt any discomfort?
10	Was your recovery from the laser easy?
11	Regarding the subsequent treatment indications, how clear were they?
12	How did you perceive the results of the treatment?
13	Have you had any cosmetic treatment before this one?
14	If you had the opportunity, would you have the procedure done again?
15	Did you have any kind of complication after treatment?

2.8 Statistical Analysis

The statistical analysis of the outcomes was performed using the IBM SPSS, the significance level was set at $P < 0.05$, and the statistics T shows that there is a significant difference between the patients who used the different rejuvenation agents.

3. Results and Discussion

3.1 Visual assessment of VISIA

As it was said, before the laser procedure, a Visia study was carried out to each patient and one month later it was done as well. The results that are shown in the following figures are the differences in percentage between both skin analysis studies and how it enhanced the delivery of the rejuvenation agents with the impact.

3.2 Spots

In the matter of spots, as we can see in FIG. 5, the best benefit was 18% decrease in spots when it was used the mixed treatment, followed by the retinol and the hyaluronic acid, this is because when the skin is well hydrated, it better controls the amount of pigment in the melanocyte.

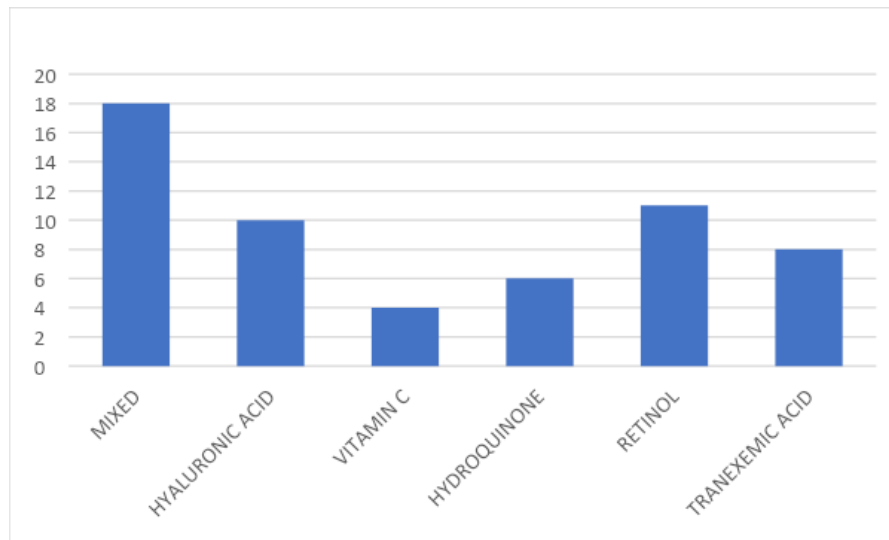


FIG. 5. Percentage of improvement in Spots while using different cosmeceuticals.

3.3 Wrinkles

As we can see in FIG. 6 there is a reduction of 60% in wrinkles with the mixed treatment from the initial Visia to the final data one month after the hybrid laser was done. It was followed by nearly 50% reduction of Vitamin C and 30% reduction with Retinol.

As we can see in this study, the vitamin C or ascorbic acid, is an excellent option for rejuvenation, it is a cofactor for collagen-stabilizing enzymes, proline and lysine hydroxylase. It activates transcription and stabilizes procollagen mRNA, reduces collagenase synthesis, donates electrons to reactive oxygen species and decreases post-inflammatory erythema and UV-induced erythema. Its activity is observed with concentrations between 5% and 10%, which is why we managed to see an improvement in wrinkles with antioxidant agents.

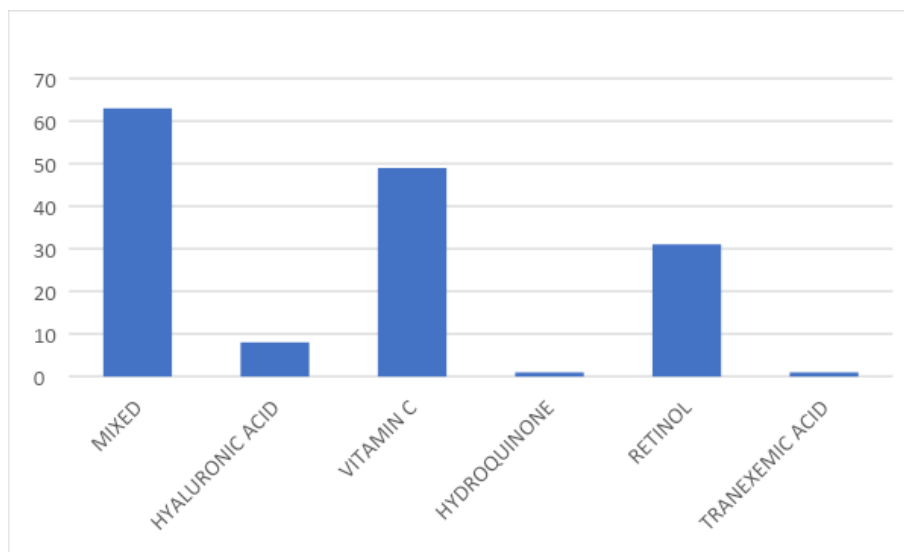


FIG. 6. Percentage of improvement in Wrinkles while using different cosmeceuticals.

3.4 Texture

In FIG. 7, we can observe that for the texture skin, there was an improvement of 26% with the mixed treatment, followed by the Hyaluronic acid with 23% and the Retinol with 19%.

Retinoids such as retinoic acid, retinol, retinaldehyde and vitamin A esters can cause irritation, however retinol and retinaldehyde are converted to retinoic acid in the skin producing similar topical benefits with less risk of irritation, for the purpose of this study, retinol microspheres were used as it was mentioned previously.

There was no significant difference in texture with either hydroquinone or tranexamic acid, but all the patients saw and show improvement in skin texture with laser regardless of the application of the IMPACT or not, and of course better results with the use of the ultrasound.

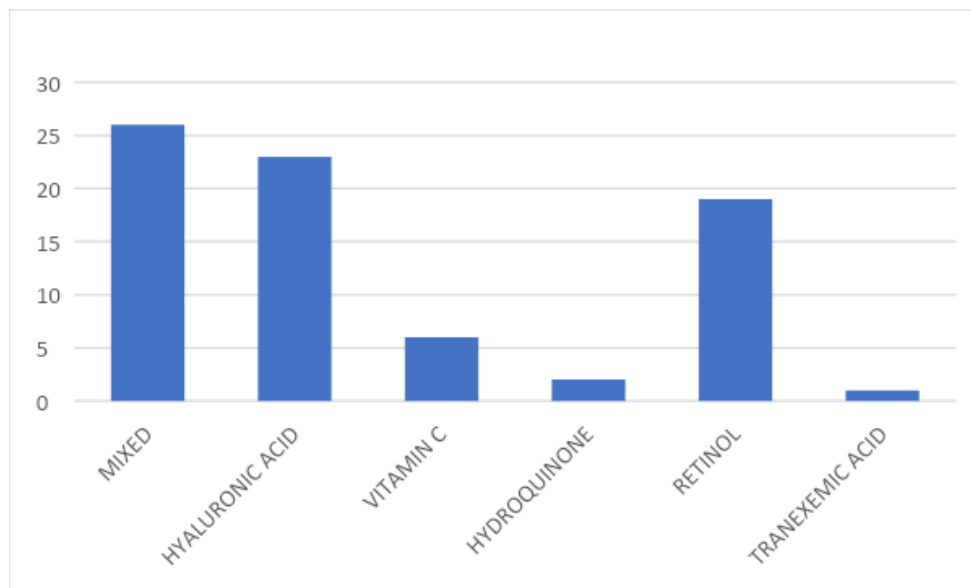


FIG. 7. Percentage of improvement in Texture while using different cosmeceuticals.

3.5 Pores

Degradation in collagen and extracellular matrix leads to laxity, rhytids, dermal and epidermal atrophy, and increased pore size. On the other hand, changes in texture are characterized by dryness, dehydration and there are dyschromia's due to hyperpigmentation, solar lentigines and telangiectasias.

FIG. 8 shows an improvement of 54% with the mixed treatment, followed by the Vitamin C, and much less with the tranexamic and hyaluronic acid and all the other agents.

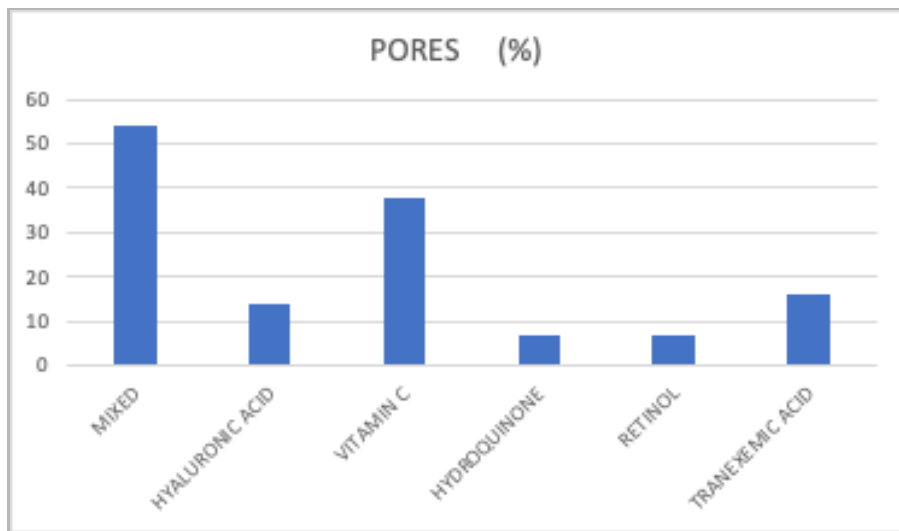


FIG. 8. Percentage of improvement in Pores while using different cosmeceuticals.

3.6 UV spots

In the following figure, it can be seen that the best performance for the UV spots is with the mixed group (35%) followed by the Retinol group (20%) and then the hyaluronic acid (9%) treatments. We have to remember that in this point the skin analysis is measuring the percentages of the melanin accumulated below the surface of the skin as a result of sun damage.

As has been mentioned before, cosmeceuticals like retinol and vitamin C help to diminish the accumulation of melanin in the melanosomes by different pathways, adding this to the laser beam to treat melasma results in a very effective option to reduce the amount of melanin in the skin.

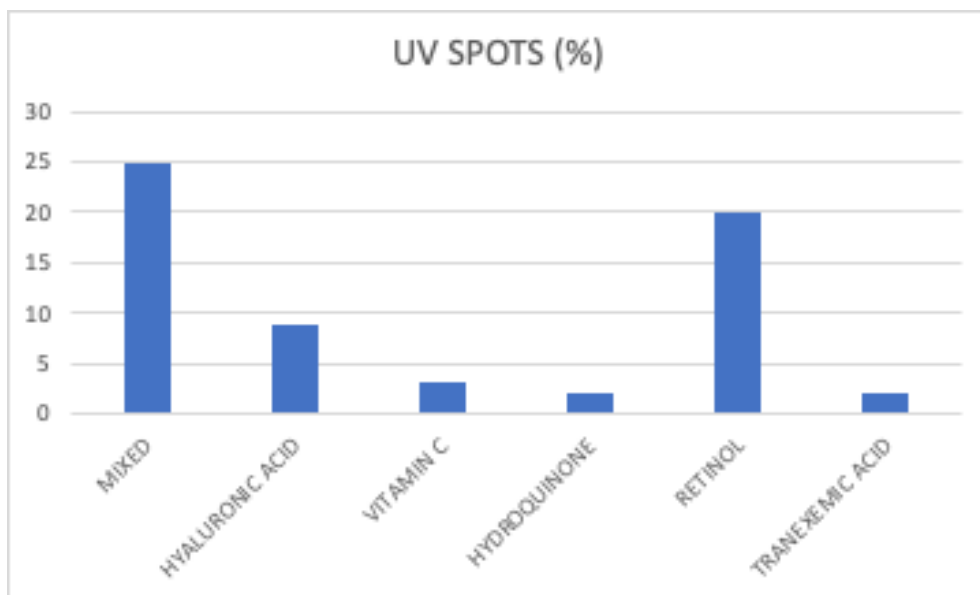


FIG. 9. Percentage of improvement in UV Spots while using different cosmeceuticals.

3.7 Brown spots

There was a 25% reduction for brown spots in the mixed treatment, followed by the Vitamin C (15%) and the Hydroquinone (7%) treatments, by using Canfield RBX’s unique Technology using cross-polarized imaging to visualize the accumulation of Melanin. We have to remember that a good treatment for melasma is hydroquinone even though the use of this product might have some complications, by using this technique we achieved good results in all the cases either epidermal or dermal melasma.

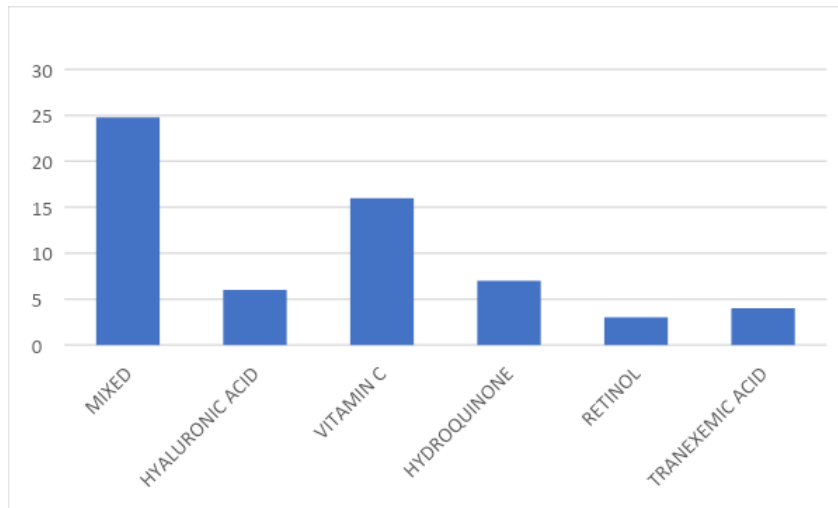


FIG. 10. Percentage of improvement in Brown Spots while using different cosmeceuticals.

3.8 Red areas

In the FIG. number 11, we can see that the mixed group has improved the best in the vascularization of the face (redness, telangiectasias, rosacea), the same happens with the application of hyaluronic acid which controls the redness and in a lower percentage the tranexamic acid, as we know, this last one helps to improve vascularization and vascularized melasma with or without the laser.

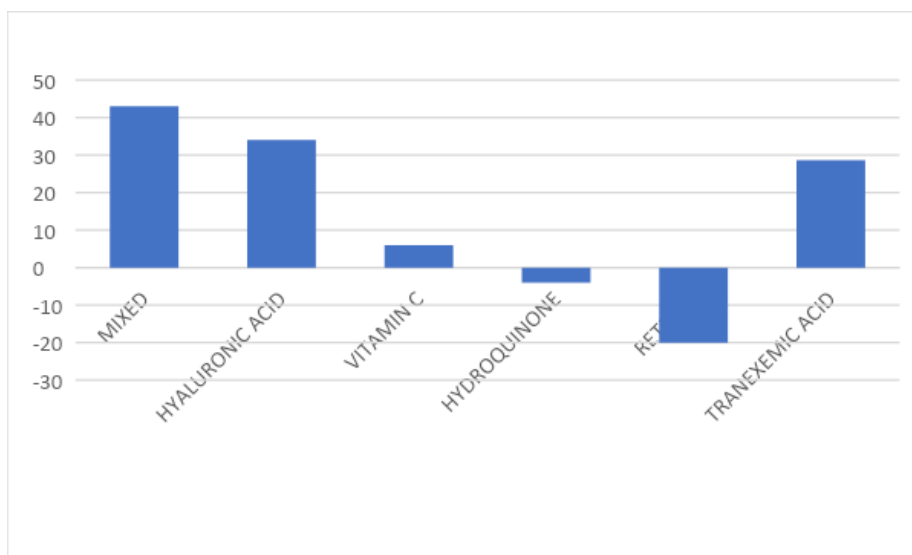


FIG. 11. Percentage of improvement in Red Areas while using different cosmeceuticals.

On the other hand, some of the rejuvenation agents used can cause irritation even though the skin has a good improvement in the vascularization factor with the laser. Also, one of the most common secondary effects after laser is erythema from the skin most of all in low skin phototypes.

It is important to mention that the patient carried on at home with a Retinol application and in some cases the redness was worst by the use of these products, especially very sensitive skins or patients that are not used to have a skincare routine. However, in the mixed group we can see improvement of the redness in all the cases.

3.9 Porphyrins

When a wavelength of 1560 nm was used, the collagen production is stimulated but also the face bait, therefore, for grease skins it could be a secondary effect because of the millium cist and the acne reactivation. The increase of porphyrins is very clear in Figure 12 when hyaluronic acid and Vitamin C were used, however this problem was improved when Retinol and salicylic acid was prescribed as a treatment at home after the laser session. In the worst cases topic Clindamycin at 1% directly in the active lesion was prescribed, with the improvement of the lesions.

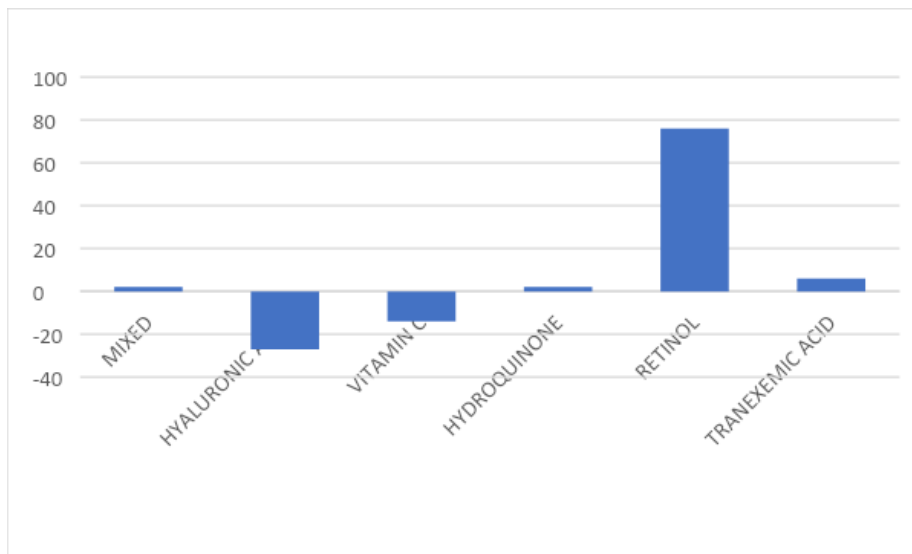


FIG. 12. Percentage of Porphyrins while using different cosmeceuticals.

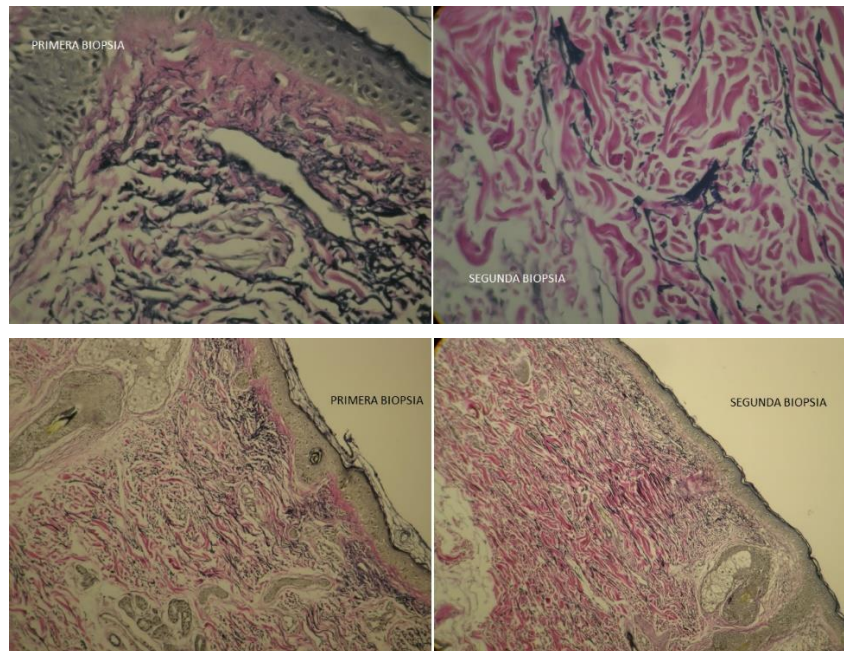
3.10 Biopsy results

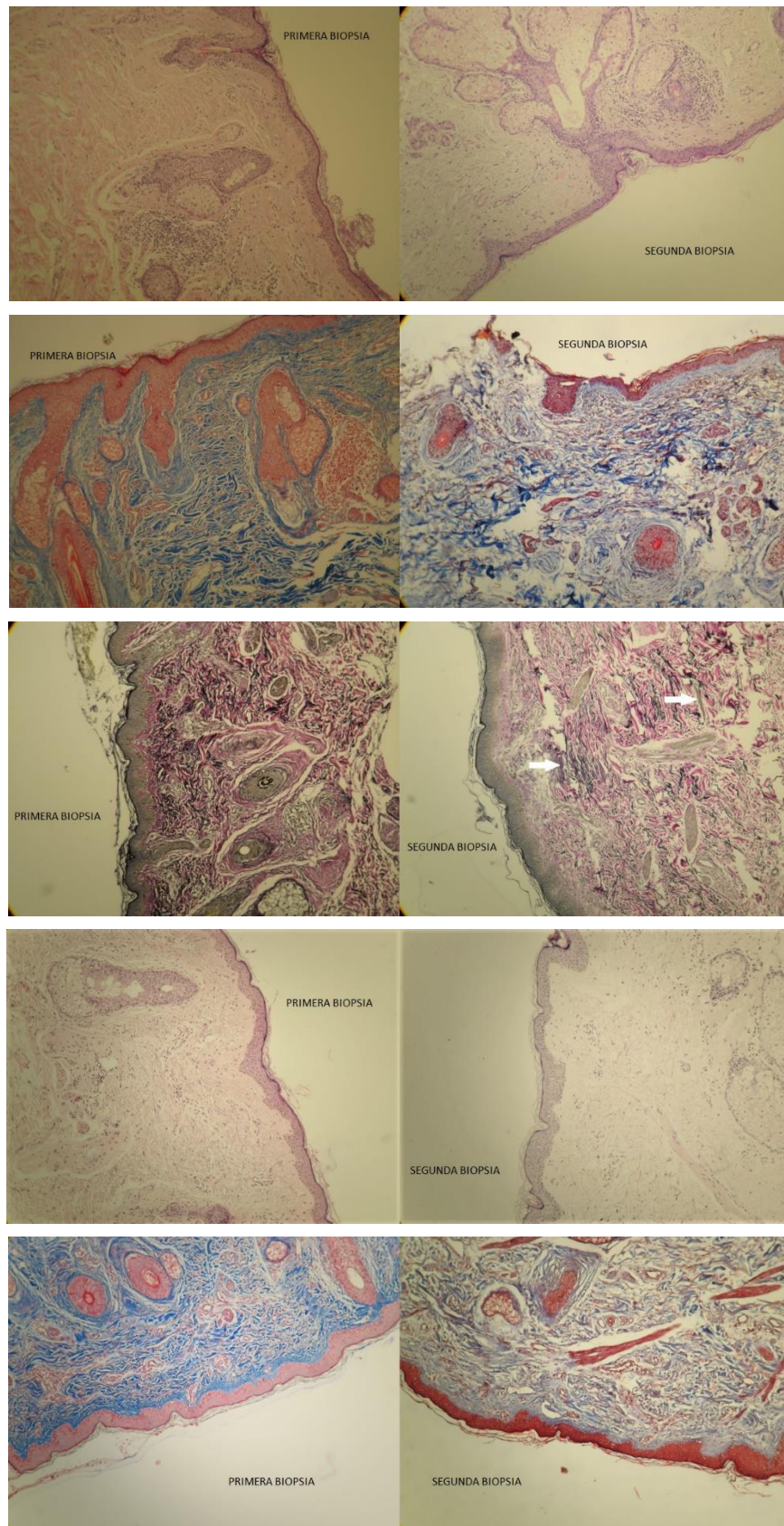
Compared to the first biopsy (qm-579), with the hematoxylin-eosin (h.e.) stain, a decrease in the periannex lymphocytic inflammatory infiltrate is identified. there is a 20%-30% increase in the quantity of elastic fibers, these, in the initial biopsy, are small, short, disorderly, and curly predominantly in the papillary dermis (pd).

In the second biopsy (qm-900) a marked order is observed, being parallel to the epidermal surface, arranged in bundles in addition to being greater thickness and length, being more numerous in reticular dermis (dr). bands look like collagen are identified that slightly capture the stain for (fe), elasticity of collagen bands.

Biopsy one	Second Biopsy
Decrease in lymphocytic inflammatory infiltrate (periannex)	A very marked order
20% to 30% increase in number of elastic fibers	Parallel to the epidermal surface
Elastic fibers: small, short, messy, and curly	Elastic fibers: greater thickness and length collagen band elastification
predominant in papillary dermis	Numerous in reticular dermis
	Collagen band elastification

In the following pictures we can observe the photographs of the biopsies that were described above.





3.11 Patient satisfaction survey

Another important point of this study was the patient's perception of themselves after the treatment. Thankfully most of them were very happy with their results and even happier when they saw their pictures before and after.

	Question	Rate	
1	How do you rate the care received during treatment (from start to finish)?	% excellent - good	77
2	How do you rate the quality of the treatment received?	% excellent - good	86
3	Was the treatment painful?	nothing or little pain	75
4	How many days did it take for your recovery?	removed in less than 1 week	92
5	How many days did the redness last?	removed in less than 1 week	92
6	How many days did the skin peeling last?	removed in less than 1 week	90
7	How many days did the scabs last on your skin?	removed in less than 1 week	94
8	Regarding the treatment at home (creams) that was indicated to you, did you like it?	Yes	90
9	Regarding the treatment at home (creams) that was indicated, have you felt any discomfort?	no hassle	100
10	Was your recovery from the laser easy?	good and very fast	88
11	Regarding the subsequent treatment indications, how clear were they?	very clear	90
12	How did you perceive the results of the treatment?	good - excellent	67
13	Have you had any cosmetic treatment before this one?	No	77
14	If you had the opportunity, would you have the procedure done again?	Yes	92
15	Did you have any kind of complication after treatment?	none	100
16	On a scale of 1 to 10, how would you rate your treatment? 10 being the highest score	9 y 10	79

4. Conclusions

As we can see in this study, the results obtained during the use of the Alma hybrid laser were so much better with the final application of rejuvenation agents right after the laser and even better with the use of the developed technology.

The use of different substances allows us to personalize each resurfacing treatment depending on the patient and the purpose that is wanted to achieve. For example, if the focus is on hyperpigmentation, retinol, vitamin C, tranexamic acid, and surprisingly hyaluronic acid can be used to improve the results of one laser session, this is explained because of the activation of the fibroblast and the regulation of the proliferation of keratinocytes. However, further research has to be done in this field.

In all cases, it was seen that combining more than 4 rejuvenation agents, the results were more evident than those who carried out with only one of them. This is understandable because by applying different products the treatment becomes more intense and improves different aging signs at the same time. Mainly in the cases of hyperpigmentation because of the multifactorial causes of this pathology.

All the patients progress remarkably

5. Study Observations

- It is much better to apply a rejuvenation agent after the laser rather than none, (however more studies should be carried out). We can also add a group without drugs using a placebo.
- The mixed group has the best result, especially in stains due to the multifactorial factor.
- Hyaluronic acid improves brown spots because it hydrates the skin, stimulates the fibroblast and calms the melanocyte.
- All patients improved a large percentage in Texture and Wrinkles.
- Vascularization also improved, however there were some patients who came out worse in this rating, it may be due to redness after the laser or the depigmenting creams that are being applied.
- In low skin phototypes, that is, lighter skin, the best results were observed and the recovery time was considerably faster.
- Patients who received hyaluronic acid left with less pain and had a faster recovery than those who received retinol or vitamin C.
- Patients with hyperpigmentation associated with the vascular component were the ones who had the greatest adverse effects (post-inflammatory pigmentation).

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