

## Eye Wrinkles: An Updated Management Overview

Ayman Elsayed Ahmed <sup>1</sup>, Mohamed Hamed Khater <sup>2</sup>, Hanaa Mohammed ALwafaey <sup>3</sup>, and Fathia khattab <sup>4</sup>

<sup>1</sup>Assistant Professor of Dermatology, Venereology & Andrology, Faculty of Medicine, Zagazig University, Egypt.

<sup>2</sup> Professor of Dermatology, Venereology & Andrology, Faculty of Medicine, Zagazig University, Egypt.

<sup>3</sup>M.B.B.Ch., Faculty of Medicine - Zagazig University, Egypt.

<sup>4</sup>Assistant Professor of Dermatology, Venereology & Andrology, Faculty of Medicine, Zagazig University, Egypt.

**Corresponding author:** Hanaa Mohammed ALwafaey

**Email:** Hanaawafaey@yahoo.com

### Abstract

**Background:** *The periorbital region plays an important role in overall facial appearance and is one of the first areas to reveal signs of ageing. The eyes in particular are often used as an immediate gauge of chronological age. Consequently, there are many different treatment modalities currently available for use or undergoing clinical investigations. The main targets of the treatments are improvement, if not elimination, of rhytids and replacement of lost volume or removal of excess volume in what is known as the tear trough region. Other characteristics of ageing skin include rough, leathery and uneven skin texture, changes in pigmentation and dryness.*

**Keywords:** *Eye Wrinkles, Periorbital Region.*

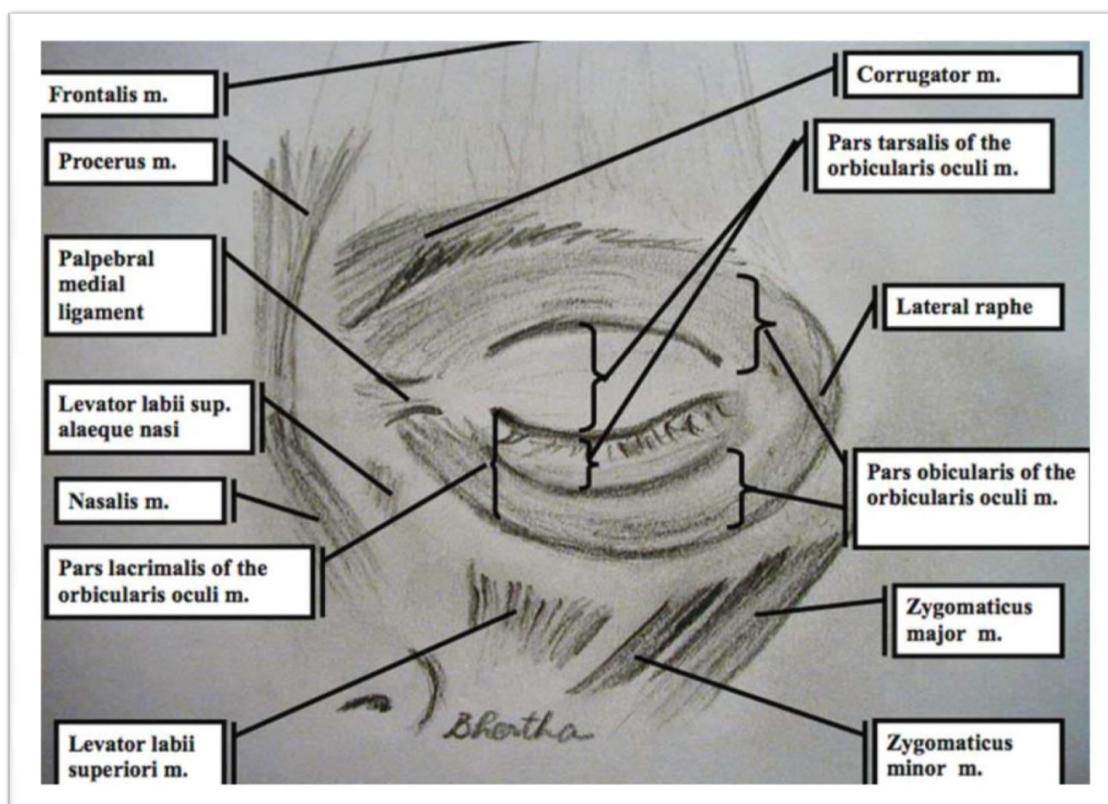
### Eye anatomy:

The eyes situate in the orbital sockets in the upper face region. The skin that is directly superior to the orbits is also the region where the eyebrows are found. Surrounding and covering the eyes are the eyelids. The eyelids divide into the upper and lower eyelids. At the edges of the eyelids are the eyelashes. The eyelids cover and provide eyes with protection. Deep to the skin over the eye region are the fat pads. The superior fat pad is superior to the orbit, but inferior to the eyebrows, while the inferior orbital fat pad is inferior to the orbit, and it contributes to the fullness in the superior cheek region. Laterally to each orbit is a lateral orbital fat pad. (1).

There is one muscle that encircles the orbit. The muscle that encircles the orbit is the orbicularis oculi muscle. The orbicularis oculi muscle originated from the frontal bone, lacrimal bone, and medial palpebral ligament. The orbicularis oculi muscle inserts into the lateral palpebral raphe. The function of the orbicularis oculi muscle is to close the eyelids. In contrast, the muscle that opens the eyelids is the levator palpebrae superioris muscle. The levator palpebrae superioris muscle is not on the face but rather is in the orbital socket. Eye movement is under the control of six muscles. The six muscles that control the eyes are the superior rectus muscle, inferior rectus muscle, medial rectus muscle, lateral rectus muscle, superior oblique muscle, and the inferior oblique muscle. The bony structures that

make the eye region are the frontal bone superiorly, nasal bone medially, maxilla anteromedially and the zygoma makes the inferior and the lateral part of the orbit. (2).

The palpebral and orbital components of the orbicularis oculi muscle surround the pretarsal and preseptal aspects and function essentially as the sphincter muscle of the eyelid, which is responsible for blinking and gentle eye closure. Its direct antagonist is the Levator palpebrae muscle. Some of the fibers of the superior medial orbital component function as depressors of the medial eyebrow, whereas the superior lateral orbital orbicularis acts partly as a depressor of the lateral eyebrow. Forceful mechanical pressure on the orbital component induces concentric folds emanating from the lateral canthus, resulting in lateral canthal lines, or “crow’s feet”. The zygomaticus major muscle forms the angle of the mouth superiorly, laterally and posteriorly, in a similar manner as seen in laughing, smiling and chewing. The zygomaticus minor muscle functions as one of the lip elevators, and both contribute to the formation of the melolabial fold. Mechanical pressure on both zygomaticus muscles produces synergistic effects in the periorbital region, which is accentuated by pressure on the orbital orbicularis muscle, and all together contributes to the formation of radially oriented folds at the lateral canthus. (3)



**Figure 1:** Anatomy of the Eye (3).

**Eye wrinkle classification**

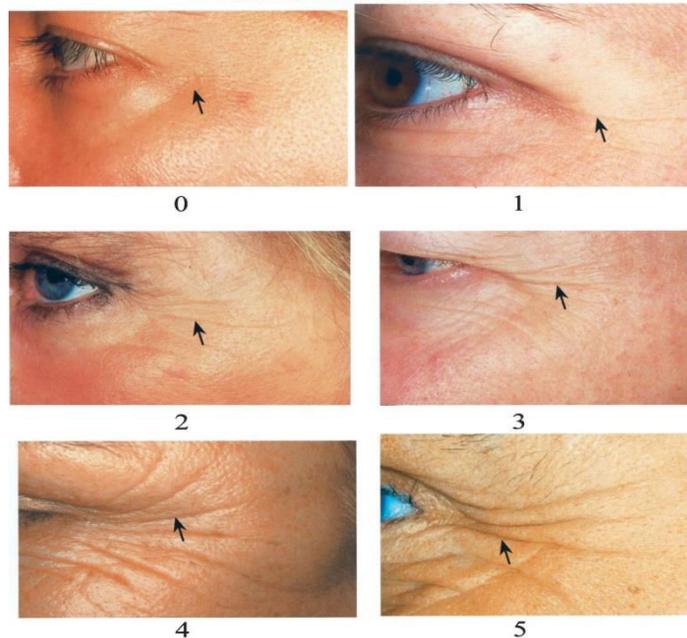
There are two types of wrinkles: static wrinkles and dynamic wrinkles. Dynamic wrinkling is a result of facial mimics that occur due to mood changes such as fear, shock, frowning, and laughing. They appear and disappear rapidly. The favored locations of dynamic wrinkles are periorbital, forehead, and glabellar areas. On the other hand, static wrinkles do not disappear rapidly, they can be seen even when the facial muscles are relaxed. Static wrinkling favors the perioral region, neck, and malar region. Dynamic wrinkles may lead to static wrinkles due to the loss of collagen with aging. Facial wrinkling is divided into 4 categories according to the Glogau Scale: stage 1 has no wrinkles and stage 4 has deep widespread wrinkling. (3).

Fitzpatrick proposed classification of perioral and periorbital wrinkling for use in establishing the effect of laser resurfacing of the skin (Table I).

**Table 1:**Classification of perioral and periorbital wrinkling for use in establishing the effect of laser resurfacing of the skin (4)

Class	Score	Wrinkling	Degree of Elastosis
I	1–3	Fine wrinkles	Mild (fine textural changes with subtly accentuated skin lines)
II	4–6	Fine to moderate depth wrinkles, moderate number of lines	Moderate (distinct papular elastosis, individual papules with yellow translucency, dyschromia)
III	7–9	Fine to deep wrinkles, numerous lines, with or without redundant skin	Severe (multipapular and confluent elastosis, thickened yellow and pallid cutis rhomboidalis)

**Periorbital Lines**



**Figure 2:** Periorbital linesLemperle Assessment Scale4; Periorbital rhytides are graded 0–5 in increasing severity; A, Grade 0; B, Grade 1; C, Grade 2; D,Grade 3; E, Grade 4; F, Grade 5 (5)

### **Methods of treatment of periorbital wrinkles**

The periorbital area is one of the most important markers of chronological age and thus an essential target in skin rejuvenation, yet it poses certain difficulties in terms of treatment. Eyelid skin is the thinnest in the body<sup>3</sup> and serves an important functional role in protecting the eyes, making this area a therapeutic challenge. The surgical procedures used traditionally, such as blepharoplasty and rhytidectomy, can result in significant downtime and risk of side effects, thus are not suitable for all patients. More conservative traditional treatments include topical agents such as retinoic acid, chemical peels, botulinum toxin, dermal fillers, and dermabrasion, but these have been largely replaced by newer technologies. Since the 1990s, ablative and nonablative lasers have revolutionized the world of facial rejuvenation. While ablative treatments have shown great promise from the start, demonstrating significant improvement in periorbital rhytids, nonablative skin resurfacing was initially met with skepticism due to its subtle and gradual effects. (6)

### **Retinoids.**

Topical retinoids are the cornerstone of treatment for photodamaged skin. The class of retinoids encompasses both naturally occurring and synthetic derivatives of vitamin A. The effects of retinoic acid on mottled hyperpigmentation, fine lines, and skin texture are well-known; however, there is less clinical research available for cosmeceutical retinoids. Retinol 1.6% when compared to 0.025% retinoic acid produced less erythema while inducing epidermal thickening and enhancing expression of cellular retinoic acid-binding protein (CRABP-II mRNA) and cellular retinol binding protein (CRBP mRNA), similar to retinoic acid. Retinaldehyde has been shown to be significantly efficacious in reducing fine lines and improving skin roughness when compared to retinoic acid. Levin et al identified sufficient evidence of cutaneous penetration and supported the use of retinaldehyde and retinol to decrease fine lines and wrinkles(7)

### **Chemical peeling (Blepharo-peeling)**

The most commonly used alpha hydroxy acids (AHA) are glycolic 20% and lactic acid 15% which reduce periorbital pigmentation. Vavouli et al reported an improvement of up to 90% in dark circles following treatment with 3.75% trichloroacetic acid and 15% lactic acid.<sup>16</sup> Segmental chemical peel with phenol-croton oil (27.5% phenol and 0.1% croton oil) has been used successfully for periorbital wrinkles. This cost-effective modality has been associated with long-lasting neocollagenesis, and cardiac monitoring is not required when treating 1 or 2 facial units. (8)

### **Neuromodulators**

The use of botulinum toxin type A has revolutionized the nonsurgical esthetic treatment of the upper face. In fact, botulinum-induced chemo denervation has become an integral part of the plastic surgery armamentarium for the treatment of aesthetic problems such as glabellar and periorbital wrinkles, Botulinum neurotoxins act by inhibiting the release of acetylcholine from vesicles on presynaptic nerve endings. This blockade produces a reversible but long-acting denervation which impairs muscle function; on the contrary, non-depolarizing muscle relaxants induce a specific competitive pre-synaptic and post-synaptic neuromuscular block which is rapidly reversible. (8).

**Mechanical Resurfacing (dermo abrasion)**

Mechanical resurfacing consists of forming microscopic abrasions to the most superficial skin layers. This can include the use of a motor driven device releasing crystals of aluminum oxide, termed microdermabrasion, the use of sandpaper that is repeatedly passed onto the periorbital area with varying force using one's hand, termed manual dermabrasion, or motorized dermabrasion. Motorized dermabrasion is the least suitable form to be used in the periorbital region due to the likelihood of injury since the skin in that area is very thin and control of eyelid motility can be difficult. On the other hand, manual dermabrasion is the most suitable method for the periorbital area since it allows very specific control of the depth of tissue involved and the force being applied to the area. (9)

**Radiofrequency**

Radiofrequency (RF) devices for skin rejuvenation have also been introduced. This technology produces volumetric heating via tissue impedance and subsequent heat diffusion, and it affects deeper tissue layers than laser-based methods. As with laser therapy, the fractional devices deploying RF have also been introduced to improve efficacy and tolerability. One of the fractional RF devices has used the term "sublative rejuvenation" because the skin remodeling occurs deep below the minimal epidermal ablation and at a sublative level of heating (9)

**Microplasma radiofrequency**

Micro-plasma radiofrequency (RF) has been introduced as a new modality in dermatology. Ablative microplasma RF is a non-laser, non-light-based technology capable of inducing epidermal resurfacing and dermal coagulation. Micro-plasma radiofrequency makes use of a discharge of radiofrequency energy which acts on nitrogen molecules in the air close to the surface of the skin resulting in ionization of a portion of the atoms to form high-energy foci called plasma sparks. Energy is released upon return of the gas ions to their former steady state. (10) .

These sparks when applied evenly onto the skin create multiple controlled channel like perforations in the epidermis. It produces micro-ablative epidermal thermal zones comprised of coagulated and thermally denatured columns in the skin, with surrounding viable tissue acting as a reservoir of stem cells, growth factors, and inflammatory cells that facilitates rapid re-epithelialization. This rapid epithelialization leads to considerably less downtime with reduced morbidity as compared with other ablative resurfacing techniques. (11).

**The DAS (Dermo Ablation Surgery)**

Medical is a plasma blade, an electrocautery device which induces a plasma voltaic arc causing the tightening of epidermis and superficial dermis. The energy generated by the DAS Medical\_ device is direct voltage current which elevates the temperature of the skin. The mechanism of direct voltage current fulguration is different from the controlled delivery of voltage current achieved discharge with AC: it affects a much smaller area of skin and does not damage the surrounding tissues. When the tip of the device is applied to the skin with a 2 mm distance, the electrons present in the atmosphere tend to sequester part of the energy delivered. Air stops being an insulator is conducted; the ionized air is led: the ionization is called "plasma" (12).

**Platelet-rich plasma**

The past decade has also seen the emergence of platelet-rich plasma (PRP) as a treatment option

for rejuvenating the skin's appearance. Early clinical trials examining PRP for treatment of periocular wrinkles from 2010 to 2016 lacked control groups but demonstrated that both PRP and PRGF provide statistically significant improvements in overall skin appearance, wrinkles, firmness/saggingness, and color homogeneity. (13).

### **Plasma skin technology**

Once, the only possible treatment for the aging of periorbital area was surgical (blepharoplasty), or laser assisted or by injecting fillers since about a decade, a noninvasive plasma technology is available to treat dermatochalasis and crow's feet. (8).

Plasma skin regeneration is a novel type of skin rejuvenation technology developed over the last years the technology can present itself in four different phases: solid, liquid, gas, and plasma. By adding heat or energy to a gas, this is transformed into plasma: the atoms that make up the gas begin to lose their electrons and become positively charged ions. The lost electrons are then able to float freely. This process is called ionization. And when this process has involved most of the gas, then it is called plasma devices using plasma technology deliver thermal energy directly to the tissues at the time of contact, without relying on skin chromospheres (13).

### **Microneedling**

Microneedling also known as percutaneous collagen induction (PCI), is a simple method for treating atrophic scars, wrinkles, and inoculation of subcutaneous drugs. In this method, a mechanical trauma is induced into the epidermis and the dermis. The epidermal trauma is quickly recovered through transepidermal migration, while the dermal trauma is restored through collagen repair. (14).

### **Injectables (Fillers)**

The most commonly used substance to reach adequate cosmetic results and counteract the aging process is hyaluronic acid. It is especially useful in the periorbital area and can lead to excellent results in the hands of an experienced physician. Hyaluronic acid is glycosaminoglycan disaccharide that is found in human skin, synovial fluid and vitreous fluid. it is a molecule that binds water very avidly and remains bound to it until it is degraded. This allows the molecule to keep giving the face volume until it completely disappears (15).

Common areas injected include the brow, the upper eyelid and the tear trough. It is very important to inject only small quantities of the product and to avoid overcorrecting the defect as this can lead to patient dissatisfaction. In addition, if the midface area is going to be injected, it should be targeted prior to the treatment of the periorbital area since the former can reduce the depth of the tear trough and thereby will lead to less product quantity used in the latter.(15).

Common side effects include ecchymosis, erythema and mild edema, which can be encountered with any face injection. More serious side effects can occur from the inadvertent injection of material into blood vessels, leading to necrosis of the injection site, and also embolization of material and occlusion of arteries. In the periorbital area, this is of particular concern since the ophthalmic artery can get affected, leading to permanent loss of vision, Fortunately, these side effects are rare and become even rarer in experienced hands.(16)

### **Laser resurfacing**

Carbon dioxide (CO<sub>2</sub>), Erbium Yag Ablative and fractional ablative lasers using CO<sub>2</sub> and Erbium Yag were among the earliest lasers used to treat wrinkles and rhytids. The treatment of dermatochalasia and periorbital rhytids with CO<sub>2</sub> laser by Alster and Bellew showed significant

improvements in the appearance. Ablative lasers are ideally suitable for lighter skin types as they have significant downtime. (17)

The Er: YAG laser has a wavelength of 2940 nm and its target chromophore is water, similar to the CO<sub>2</sub> laser. However, due to its longer wavelength, the Er: YAG laser penetrates tissues more superficially compared to the CO<sub>2</sub> laser, and also leads to less heat formation and less tissue vaporization. (15).

This is mainly why its use has been advocated for superficial wrinkles while CO<sub>2</sub> laser is more commonly used for deep wrinkles. However, when it comes to the periorbital area, both lasers have been found to be equally effective in the treatment of both superficial and deep rhytids. Advantages of the Er:YAG laser over the CO<sub>2</sub> laser include decreased incidence of skin reactions due to the decreased intensity of vaporization and intradermal heat formation. While Er: YAG usually leads to a faster recovery, this comes at the expense of less collagen tightening and the possibility of needing more sessions when using this laser compared to the CO<sub>2</sub> laser (16).

Nonablative lasers Like intense pulsed light (IPL), pulse dye laser (PDL), Nd: Yag 1320nm, Nd: Yag 1064nm, and Erbium glass 1540 nm are safer treatment options for periorbital rejuvenation. In a study conducted on 31 patients, an improvement in eyelid tightening and eyelid aperture was reported using a fractionated 1550-nm erbium doped fiber laser with no major side effects. The use of fractionated 1410-nm nonablative laser was found to be effective in improving skin flexibility and wrinkles in the peri-orbital area. 1927-nm Thulium fiber laser can achieve skin rejuvenation by increasing collagen and reduction in melanin. The use of nonablative laser is increasing due to the safety profile and low downtime (18).

### **Plasma skin resurfacing**

Plasma skin resurfacing (PSR) This emerging method utilizes the state of matter known as plasma to create a thermal effect on the skin through the use of positively ionized gases. With PSR, a gaseous nitrogen source is used to form a plasma. Unlike ablative lasers, this modality is not chromophore-dependent, and therefore, it does not vaporize tissue. This modality may function by forming a layer of desiccated epidermis creating a natural barrier that facilitates accelerated healing with generation of new epidermis(19).

Plasma resurfacing has been used safely in skin types I-IV and may have a better safety profile than ablative laser. This modality has been used with good results in full- facial resurfacing. In a recent study, the use of this technology has shown good response to treat periorbital area for dermatochalasis and wrinkles(13).

**Conflict of Interest:** No conflict of interest.

### **References**

1. **John D. Nguyen; Hieu Duong. (July 27, 2020)**, Anatomy, Head and Neck, Face, Florida Atlantic University.
2. **Nguyen JD, Duong H. StatPearls [Internet]. (2020)**. StatPearls Publishing; Treasure Island (FL): Aug 13, 2020. Anatomy, Head and Neck, Cheeks.

3. **Borut Poljsak, Aleksandar Godic, Rok Fink. et al. (2015).** Sleeping on an Anti-Wrinkle Pillow Reduces Facial Wrinkles. *Forensic Medicine and Anatomy Research*, 2015, 3, 48-56.
4. **Munir Alam. (2020).** facial wrinkle and its treatment. *Journal of Pakistan Association of Dermatologists*. 2020; 30(1): 175-180.
5. **Riza R. Milante, Melanie Joy Doria, Mercedes Buenviaje Beloso, et al. (2020).** comparison of grid fractional radiofrequency vs 1064-nm Nd-YAG laser treatment of periorbital rhytides among Filipino patients. *Dermatologic Therapy*. 2020;33: e14031.
6. **Tamir Horovitz, Matteo Tretti Clementoni, Ofir Artzi. et al. (2021).** Nonablative laser skin resurfacing for periorbital wrinkling—A case series of 16 patients., *J Cosmet Dermatol*. 2021; 20:99–104.
7. **Stacey J Pilkington, Sarah Belden, Richard A. Miller. (2015).** the Tricky Tear Trough A Review of Topical Cosmeceuticals for Periorbital Skin Rejuvenation. , *J Clin Aesthet Dermatol*. 2015 Sep; 8(9): 39–47.
8. **Lee KC, Sterling JB, Wambier CG, et al.** Segmental Phenol-Croton oil chemical peels for treatment of periorbital or perioral rhytids. *J Am Acad Dermatol*. 2019, 81(6), e165-e166.
9. **Brauer JA, Patel U, Hale EK. (2013).** Laser skin resurfacing, chemical peels, and other cutaneous treatments of the brow and upper lid. *Clin Plast Surg*. 2013;40(1):91–9.
10. **Shin, M. K. et al. (2013).** Characterization of microthermal zones induced by fractional radiofrequency using reflectance confocal microscopy: a preliminary study. *Lasers Surg. Med*. 45, 503–8, 2013.
11. **Wang, L. Z., Ding, J. P., Yang, M. Y., Chen, D. W. & Chen, B.** Treatment of facial post-burn hyperpigmentation using micro-plasma radiofrequency technology. *Lasers Med. Sci*. 30, 241–245, (2014).
12. **Pierre Antoine Giroux, Barbara Hersant, Mounia SidAhmed-Mezi et al. (2019).** Springer Science Business Media, LLC, part of Springer Nature and International Society of Aesthetic Plastic Surgery 2019.
13. **Adam G. Evans, Mirjana G. Ivanic, Mina A. Botros, et al. (2021).** Rejuvenating the periorbital area using platelet-rich plasms. Springer-Verlag GmbH, DE part of Springer Nature 2021al Research) *Archives of Dermatological Research*.
14. **Reza M. Robati, Behnaz Hamedani, Nastaran Namazi, et al. (2020).** Efficacy of microneedling versus fractional Er:YAG laser in facial rejuvenation. *J Cosmet Dermatol*. 2020; 00:1–8.
15. **Glaser DA, Kurta A. (2016).** Periorbital rejuvenation: overview of nonsurgical treatment options. *Facial Plast Surg Clin North Am*. 2016;24(2):145-52) pp 35-50.

16. **H. Dabbous, R.Chalhoub ,N.Kawa. (2020).** Aging of the Orbit and Rejuvenation Options. In book: Periorbital Rejuvenation (pp.35-50). DOI:10.1007/978-3-030-46866-8\_2.
17. **Toyos MM. (2017).** Continuous wave fractional CO2 laser for the treatment of upper eyelid dermatochalasis and periorbital rejuvenation. *Photomed Laser Surg.* 2017;35(5):278-281.
18. **Augustyniak A, Rotsztejn H. (2016) Fractional non-ablative laser treatment at 1410 nm wavelength for periorbital wrinkles revis cometrical and clinical evaluation. J Cosmet Laser Ther.** 2016;18(5):275-279). Borut Poljsak, Aleksandar Godic, Rok Fink.et al. (2015). Sleeping on an Anti-Wrinkle Pillow Reduces Facial Wrinkles. *Forensic Medicine and Anatomy Research*, 2015, 3, 48-56.
19. **Martin Kassir, George Kroumpouzos, Priya Puja MBBS, et al. (2020).** Update minimally invasive periorbital rejuvenation with a focus on platelet-rich in plasma., *J Cosmet Dermatol.* 2020; 19:1057–1062,).