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1/2

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Contents

2 The versatility of diode lasers in aesthetic dermatology
L. Belvon[1], N. Kiss[1], A. Bánvölgyi[1], S. Bozsányi[1], C. Cantisani[2], N. Wikonkál1[3], K. L rincz[1]

20 Hair loss: BDD clinical correlates
K. P.Giotis[1], C. Papageorgiou[2]

33 Efficacy and tolerability of an antiperspirant cream in hidradenitis suppurativa patients
D. Agosta, C. Ferreli, J. Anedda, S. Mertoli, L. Atzori

40 A simple technique to minimise post-inflammatory hyperpigmentation with 532 nm nano or picosecond lasers in higher skin types
F. Al-Niaimi

43 A message to the plastic and dental surgeons regarding anatomical variation of the III trigeminal branch. Analysis of literature, diagnostic-radiological correlations and case reports
F. Svolacchia[1] and L. Svolacchia[2]

58 The dermatologists dozen: twelve top tips for reducing the pain of local anaesthetics
M. Alzaid[1]; F. Al-Niaimi[2], Faisal R. Ali[3]*

62 Concerns beyond dermatology and cosmetics in our Discipline. Awareness and knowledge of sexually transmitted diseases (STDs) among population in Georgia. An epidemiological survey
M. Shvelidze[1], N. Durglishvili[2], V. Kvirkvelia[3] and Giorgi Gagua[4]

The versatility of diode lasers in aesthetic dermatology

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key words: *Diode lasers, permanent hair reduction, laser hair removal, aesthetic treatment*

Abstract

Diode lasers are one of the most used techniques among energy-based devices due to their efficacy and wide applicability in cosmetic procedures. Best known and used application is permanent hair reduction, however they are also suitable for rejuvenation, treating scars, small vessels and pigmented lesions with a favorable safety profile. The variety of indications increases the favorable marketability of these processes and equipment. In this review article, we summarize the indications, contraindications, possible side effects, efficacy, cost effectiveness of diode laser procedures.

Introduction

Based on the statistics of the American Society of Plastic Surgeons from 2019, laser hair removal was the most popular minimally invasive procedure performed with energy-based devices (EBD) (Table I). Besides that, other laser applications, as skin resurfacing, tattoo removal, treatment of veins also represent significant procedural numbers on the list. The total number of interventions with EBD's even exceeds the number of treatments with soft tissue fillers (1). The latter highlights the importance of the versatility of energy-based devices. Diode lasers fulfill this requirement since they offer versatile aesthetic treatment options for multiple indications. They provide effective solution for various problems in many fields of cosmetic dermatology. The most used application is permanent hair reduction, however it provides favorable cosmetic outcomes for the treatment of

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pigmented lesions, keloid and hypertrophic scars or vascular malformations (2-4). Furthermore, promising results were published regarding skin rejuvenation, that makes specific devices suitable to meet common patient needs with treating skin aging (5). Also, in the terms of European skin type distribution, it is the most optimal procedure covering the largest treatable population (Fig. 1). Thus, investing in such a device is economical because its field of application is growing.

Cosmetic minimally invasive procedures	2019
Botulinum toxin	7,697,798
Soft tissue fillers	2, 721,469
Chemical peel	1,387,607
Laser hair removal	1,055,456
Laser skin resurfacing -Ablative -Non-ablative	596,755 160,893 435,862
Laser tattoo removal	166,019
Laser treatment of leg varicose veins	214,800

Table I. *Statistics report show that laser hair removal is one of the most common minimally invasive treatment in the population, based on the American Society of Plastic Surgeons statistics report (1).*

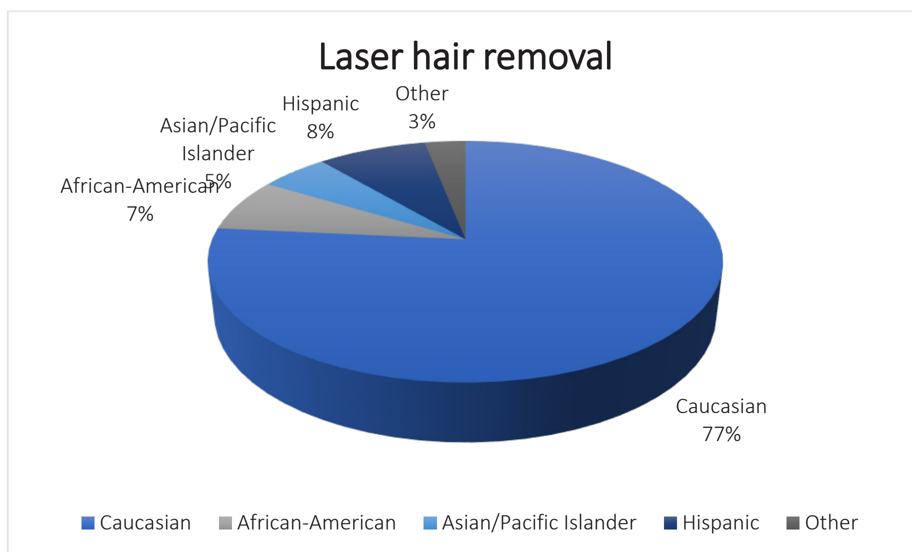

Fig. 1. *Considering the ethnicity the most common group treated by laser for the purpose of hair removal is Caucasian population (1).*

Basic principles of lasers

Lasers use stimulated amplificated lights and transfer them to an extremely intense coherent, monochromatic, collimated electromagnetic radiation in the visible and invisible spectrum. Lasers consist of an energy source which excites the electrons, a resonant chamber which contains reflective mirrors and an active medium. Lasers are named based on the type of their active medium. The active medium can be gas - carbon dioxide, argon, helium -, or solid material, like diode lasers. Most of the cases the solid material is made of glass or crystalline material which can be doped with different ions. Diode lasers are usually made of a crystal wafer with a thin layer on the surface. Depending on the emitted ranges of light, lasers are capable to act on the tissues by photodisruption and photocoagulation. Medical lasers are widely used devices with multiple clinical applications. Practitioners can cut, coagulate, or ablate tissue due to thermal effects. Thus, they are commonly used in many fields of medicine – e.g laser-assisted in-situ keratomileusis in ophthalmology, cutting and coagulating during surgery, laparoscopy, endoscopy, and bronchoscopy. Nevertheless, one of the largest markets of laser treatments are aesthetic medicine and dermatology. The following parameters are affecting the laser - tissue interactions: wavelength, fluence, pulse duration and spot size. Wavelength is affecting the absorption of the chromophores and the penetration of the skin. Chromophores absorb light on specific wavelengths (6). Dermatological application is mainly based on the theory of selective phototermolysis (7). Selective absorption of the light in different chromophores destroy certain specific targets in the skin (Table II). The fluence we use during the treatment is equal with the energy input. Pulse duration is defined by the thermal relaxation time of the targeted chromophore. Thermal relaxation time means the time necessary for the target to cool down 50% through the transfer of its heat to surrounding tissue via thermal diffusion. For example, the ideal range for laser hair removal is 10-40 milliseconds (ms) (8). In this way, lasers can treat various skin disorders and aesthetic problems without causing unwanted damages to the healthy skin tissues. The effect to the skin and the application in aesthetic dermatology is depending on which wavelength we use for the treatment.

Diode lasers can emit light on a variety of wavelength, most usually these devices are used between 800-900 nm (9). However, the field of the usage is getting wider by changing the diode lasers wavelength, depending on the purpose of the treatment. Different wavelengths are suitable to achieve the best results in the treatment of vascular malformations, pigmented lesions, laser hair removal and skin rejuvenation. Some manufacturers provide interchangeable headpiece to ensure that the diode laser can be used at different wavelengths. The headpiece can emit on 810, 940 and 1060 nm wavelengths with diode technology that delivers three wavelengths simultaneously for effective treatment on tanned and dark skin. This method provides a safe and effective treatment throughout the whole year. When used for hair reduction 810 nm is optimal for all types of hair (10). 940 nm has a better absorption in oxyhemoglobin, which provides

an effective method to coagulate micro vessels that feed the hair bulb. 1060 nm provides a very high penetration and low impact on epidermal melanin, so it is a very safe for patients with more tanned or darker skin.

Laser- wavelength (nm)	Chromophore
Long-pulsed ruby 694 nm	Melanin
Lond-pulsed Alexandrite 755 nm	Melanin
Diode-810 nm	Melanin
Diode-940 nm	1,055,456
Diode-980 nm	Melanin
Diode-1060 nm	Melanin
Long-pulsed Nd:YAG 1064 nm	Water
Long-pulsed Nd:YAG 1320nm	Water
Diode 1450 nm	Water

Table II. *Chromophores on specific wavelengths. Based on Caroll L. et al. with modifications (10).*

Different applications of diode lasers

The most widely used application of diode lasers is permanent hair reduction, that is discussed in detail in the following chapters. However, based on the literature, this technique may be advantageous in other fields of aesthetic dermatology as well, depending on the wavelength of the diode laser that is used.

Pigmented lesions

The treatment of pigmented lesions with laser therapy is controversial. There are several studies that examine the effect of laser for pigmented lesions. There are reports of clinical, dermoscopic and histological results which shows regression of pigmented melanocytic lesions after hair removal (11). Due to the fact that absorption in the wavelength range of diode lasers is dominated by melanin, choosing the right parameter is essential to avoid unnecessary risk (12). Moreover, it is important to consult an expert dermatologist to identify the possibly treatable lesions. It was

reported that using high-power diode laser at 755 nm can be useful to treat benign pigmented lesions especially solar lentigines (13). According to this study high power diode laser can eliminate certain aesthetically unpleasant pigmented lesions. The treatment was applied for a Caucasian woman with Fitzpatrick IV phototype. The parameters for the procedure were 755 nm wavelength, 21 ms with long pulse duration, 25 J/cm2 fluence. After 10 days a complete remission of the solar lentigines was detected. It is an effective treatment option not only for solar lentigines but also for hyperpigmentation of the skin, including melasma, which may cause persistent psychosocial problems for the patient and effective treatment options are limited (2). Previously a research group investigated the effect of fractionated non-ablative diode laser treatment at 1955 nm wavelength for melasma amongst patients with darker skin type. In the research they separated a group for patients with Hidroquinon use and patients with moisturizer. After a therapy session which included 4 treatment with 2 weeks pause between the sessions results were compared. There was significant improvement in hyperpigmentation after the therapy both groups. The patients in both groups had a darker skin type between Fitzpatrick III-V (14). Ephelides is an epidermal pigmented lesion which is very difficult to treat with laser therapy and its usually returns back after therapy sessions, Hidroquinon usage may be required during the treatments (15). Treating pigmented lesions is a question which must be wisely considered. Treating epidermal lesions including Ephelides, lentigines, Café au lait macules may provide satisfying results, while treating dermal pigmented lesions is a difficult and controversial question. In dermal pigmented lesions the first treatment option must be surgical excision, however there are some cases when after a detailed examination by an expert dermatologist laser removal may be considered (15).

Rejuvenation and scar treatment

High power diode laser at 1060 nm proved to be an effective rejuvenating procedure, it can reach the efficacy and safety of neodymium:yttrium-aluminum-garnet (Nd:YAG 1064 nm) solid state laser that is a commonly used rejuvenating procedure. It was reported that facial sagginess and nasolabial fold wrinkles were successfully treated in only four sessions with a high-power diode laser at 1060 nm, 10J/cm2 fluence and 400ms pulse duration. As a result remarkable improvement was shown in the nasolabial fold wrinkles volume and depth analyzed by 3D measurements (5). In this setting the target chromophore is mostly water. Absorption in water and heat production lead to activation of Heat shock protein 47 (Hsp47), which has an important role in collagen production and skin rejuvenation (16).

Besides rejuvenation pathological scar formation could be also treated with diode lasers. Keloid and hypertrophic scars are caused by an excessive tissue response to skin injury, which triggers fibroblast proliferation and collagen overproduction. Ablative and non-ablative laser therapy is an efficient way to treat keloid and hypertrophic scars (17, 18). Non-ablative treatment including diode laser on 980-nm targets mainly oxyhemoglobin that selectively

damages blood vessels that supply the scar tissue (19). Good results were shown in treating acne keloidalis nuchae (AKN), which is a chronic inflammation that involves hair follicles and causes scarring alopecia (20). It is usually treated with oral antibiotics, steroids or retinoids, however usually only limited success can be achieved (21). AKN is often cosmetically disfiguring and have a negative impact of life quality. In a recent report, with 4 sessions of diode laser treatment during 6 months on the affected skin area, 95% clearance was achieved and also no new lesions were observed during the treatment period (21). Also, light based therapies had a good effect on treating acne vulgaris, which is a common dermatological problem and its treatment is difficult, but for those patients who suffers from acne vulgaris, it can cause an emotional distress. Using diode laser on 1450-nm showed to be useful for treating the underlying pathogenic factors, including excessive sebaceous gland activity, increased inflammation and bacterial colonization. Moreover, it has a significant effect for acne scarring (22, 23). Another form of scarring is the development of striae distensae (SD), which is a very common and frustrating problem amongst women. Several procedures have been developed to alleviate this stubborn condition, including ablative and non-ablative lasers. Targeting water, melanin and hemoglobin to trigger collagen and melanin production, along with decreasing vascularity may lead to cosmetic benefits (24). Diode laser was successfully used for treatment of atrophic scars and striae at 1450 nm with 4 ,8 and 12 J/cm2 fluence over three sessions in six-week intervals. However, it was revealed that it is not effective in the treatment of striae in patients with skin type IV, V and VI (25).

Vascular lesions

Nd:YAG (1064 nm) and Alexandrite lasers (755 nm) are recommended for treating vascular malformations. Studies even proved that long-pulsed Alexandrite laser was effective for treatment of resistant and hypertrophic port wine stains (3, 26). Based on previous studies, 1060-nm high-power diode laser can be an alternative solution for treating vascular malformations, since the 1060 nm range has a better oxyhemoglobin absorption compared to melanin absorption. Better oxyhemoglobin absorption makes the photothermolysis in microvessels more effective. Furthermore, the deeper penetration of 1060 nm compared to 755 nm results in a better effect on deeper vascular malformations. For this reason, diode lasers operating at 1060 nm wavelength may be superior to Alexandrite laser (26). Laser can be used not only for small varicose veins but also to treat telangiectasias and reticular veins (27). Based on a clinical study, 800 nm high power diode laser is an effective method to treat patients presenting with leg vessels between 0.4 and 1 mm. The target chromophores for diode laser is oxyhemoglobin. During the sessions, oxyhemoglobin absorbs the energy of the laser, transferring heat to the vascular epithelium, and causing a denaturation of the vessel wall. At 800 nm wavelength, less energy is absorbed by the melanin, which acts as a competing chromophore, than when shorter wavelengths are used. As a result, it is possible to reduce side effects caused by interaction with the melanin in the epidermis (28). In this study it was shown that optimal treatment parameter is a fluence of 40 J/cm2 at a 30 ms pulse width.

Body contouring

Body contouring has become increasingly popular and wide ranges of possibilities are available to achieve the results. It was shown that 1060 nm diode laser has high efficacy on non-invasive body contouring, using the mechanism of hyperthermic lipolysis (29, 30). This wavelength provides a safe method by achieving hyperthermic temperatures in adipose tissues. It effectively targets unwanted adipocytes without making any harm to the skin and appendages. Also, it was shown, that a combined topical skin tightening concentrate with a hyperthermic laser lipolysis device may achieve improved aesthetic outcomes without any notable adverse events (31).

Laser hair removal

As the cited survey (Table I) shows hair removal is the most popular EBD procedure. Both women and men are looking for an optimal solution to remove the unwanted hair. There are many options including waxing, shaving, epilating, being treated by Intense Pulsed Light (IPL), but none of them are as effective as laser hair removal. The application of IPL technology (400-1400 nm) is still a popular choice, because of its lower expenses compared to lasers. Additionally, it has a large spot size and it can be suitable for Fitzpatrick skin types I and II (32). However, IPL treatment takes more time and it is more painful for patients and the result does not approach the efficiency of the diode laser either (33). Using lasers is not only beneficial because of its convenience for hair removal, but also because there is currently no other method on the market that is capable of permanent hair removal with such efficiency. During procedure the target chromophore is melanin in the hair shafts that absorbs light in the range of 300-1200 nm. Consequently, this range of wavelength is applicable for hair reduction. The laser energy of the diode is converted into heat and destroys the highly absorbing targets according to the principle of selective photo thermolysis (34). Also, there is an extended theory about the destruction of the weakly absorbing parts, which is based on heat diffusion caused by the highly absorbing targets. The hair matrix and the stem cells in the bulge are containing high concentration of melanin. Melanin absorbs and collects the energy causing a high temperature locally which distributes to the surrounding follicular structures and destroys them. Given the damage of the follicular structure, the hair is unable to grow in the future (7). When comparing different methods, it can be seen, that there are a lot of procedures and devices on the market, that are suitable for permanent hair reduction. Although not all of them are painless, and neither of them can be as effective as laser hair removal. Ruby laser operates on 694 nm wavelength and it can be suitable for treating fair type of skin, Fitzpatrick I-III. However, it is not a good option for darker skin as it is absorbed in the surface layers, so epidermal interference can cause skin burning (35). Alexandrite laser uses 755 nm wavelength. Similar to Ruby laser, it can also be used to treat light skin types, however, it is not a safe to treat darker skin due to the melanin content of the epidermis (36). The Nd:YAG laser (1064nm) can be used up to Fitzpatrick VI, that makes it the most suitable for dark skin types.

The Diode laser on 810 nm is providing a good solution for the treatment of all Fitzpatrick skin types I, II, III, IV and V. Due to its longer wavelength, it is absorbed in the deeper layers of the skin, so it can destroy hair follicles more selectively. In terms of the ethnic composition of the European population, the use of the Diode laser is the most advantageous in terms of cost-benefit (Table II).

All the manufacturers are trying to develop devices that can reach the optimal temperature to destroy the hair follicle without affecting the skin. During laser hair removal, diode lasers can be used on different wavelengths. The longer the wavelength is, the deeper it can penetrate to the skin. It is important to choose the correct wavelength suitable for the patient's skin pigmentation. In this way it is possible to increase the selectivity and to reduce the chance to make any damage to the skin. Using the 755 nm wavelength is optimal for individuals in Fitzpatrick categories I and II, while the 810 nm application is the safest for phototype II, III, IV. The 1060 nm range can be safely applied to phototypes IV, V and VI. Nowadays and in future all these benefits are going to be available in one device thanks to the so-called combined heads that operate simultaneously on different wavelengths (Table III, IV).

Type of laser	**Wavelength**	**Suitable for**	
RUBY LASER	694 nm	Fitzpatrick I- III	lighter skin types with dark hair
ALEXANDRITE LASER	755 nm	Fitzpatrick I- III	better penetrance than ruby laser, suitable for lighter hair
DIODE LASER	810 nm	Fitzpatrick I-V	penetrates deeper, less epidermal damage, safer in darker skin
Nd:YAG laser	1064 nm	Fitzpatrick I- VI	better penetration, less epidermal damage, less melanin absorption
Intense Pulse Light (IPL)	400-1400 nm	Fitzpatrick I-II	high intensity pulses of polychromatic, non-coherent light, less expensive than a true laser, but not as effective

Table III. *Different type of lasers and their usability.*

Using diode laser on different wavelengths		
755 nm	810 nm	1060 nm
◦ laser hair removal, better efficacy on fair skin types ◦ pigmented lesions such as lentigines	◦ laser hair removal for a wide range of skin types	◦ laser hair removal, better efficacy on darker skin types ◦ body contouring-hypertermic laser lipolysis ◦ skin rejuvenation ◦ acne treatment ◦ venosus malformations: hypertrophic capillary malformations, cherry angiomas

Table III. *Using diode lasers on different wavelengths.*

Indications for hair reduction

The purpose of laser hair removal is to reduce the unpleasant hair in the areas such as legs, arms, armpits, around genitals, face. It is not only an aesthetic problem but for those who suffer from extreme hair growing conditions such as hormonal problems, it can seriously damage self-confidence, leading to deprivation and depression. There are certain conditions that must be met for the procedure to be successful. Laser light is absorbed in melanin chromophores, because of that it is necessary that the hair should be pigmented in the area to be treated. Not only is the pigmentation of the hair being essential, but also the contrast between the skin and hair color. The higher the contrast, the better the efficacy of the treatment is, and the lower the risk of unwanted side effects are. Blond, white, red and gray hair cannot be treated in the absence of enough pigment. Laser hair removal can be done on all Fitzpatrick skin types; however, the most remarkable result can be achieved on skin type II and III. Effective laser treatment methods have also been developed for skin type V to VI by changing the wavelength of the laser applied for the more pigmented skin.

Contraindications of hair reduction

Diode laser procedures are safe and effective in general, but for all laser treatments there are certain medical conditions and contraindications that needs to be considered for safety. Certain medical conditions including psoriasis, bleeding disorders, vitiligo, history of melanoma, raised naevi, suspicious lesions, wound healing problems -e.g. history of keloid, diabetes- not

recommended to treat. Having metal implants in the treated area is a contraindication as well. Also, it is contraindicated to treat patients with autoimmune diseases such as vitiligo, scleroderma and systemic lupus erythematosus (SLE), since laser treatment can lead to a flare up. In patients with history of light triggered epilepsy laser hair removal should be avoided. Furthermore, in conditions with unstable hormone levels, such as pregnancy, breastfeeding, thyroid problems and hirsutism can affect the procedure's effectiveness, because these conditions can cause an excessive hair growth. Thus, it is uncertain if that the treatment will succeed, or more sessions will be needed during the procedure. Also, if there are active infections, herpetic lesions, cold sores, tattoos or permanent make-up, previous surgery, chemical peels or laser resurfacing in the area to be treated it is not recommended to apply the procedure. Taking medications that cause photosensitivity including certain antibiotics especially tetracycline, dapsone, fluoroquinolone, sulfonamides, quinolones acne medications such as isotretinoin, anti-inflammatory medications, steroids, chemotherapy medications also contraindicate the treatment. Treating patients who were exposed to severe sun burning should be avoided, because the skin is sensitized and also it is not allowed to treat the area if the skin color is darker than the hair wished to be removed, because it has a higher chance to burn the skin during the procedure.

Laser hair removal with diode laser on 855nm

Preparation

Before every treatment it is needed to consult with an expert physician. It is important to discuss every medical condition that can affect the treatment. Besides patients should inform the practitioner about the current medicines and health condition. Patients are instructed by the practitioner not to use any kind of body care product on the treatment area, not to use tanning bed or take any medicine which can cause photo sensibility. Permanent laser hair removal can only be effective, if the treated area is only shaved during the sessions and no other depilation method like wax, epilation, shaving cream is used. Patients are instructed to shave the area the night before the treatment. The previous information has a key importance, because during shaving the connection between the hair and the hair follicle remains continuous. So, the laser light can be easily absorbed by both the hair's and the follicle's melanin pigment. A successful treatment requires individual settings, based on the skin type. Choosing the right laser is important to reach our aim, also it is extremely important to set the adequate fluence and pulse duration.

Procedure

First step of the treatment is to clean the area, remove make up, and contamination as much as it is possible. After the decontamination process, we should examine the area of the skin if there are any pigmented naevi on the area or any specific dermatological problem including different skin lesions, scars and tattoos. The practitioner applies white marker or paint on the surface of

the specific lesions or tattoos, since laser light cannot target white color spots. Although if there are a lot of moles in the area, it is better to avoid treating that area for the patient's safety (Fig. 2).

Fig. 2. *Treating with diode laser (810 nm). Using an ultrasound contact gel is useful for cooling the treated area.*

Depending on which manufacturer's product is used for the treatment, certain devices may require the use of a contact gel. The main role of contact gel is to slide the probe easily on the surface, and on the other hand it is also used as a cooling medium during treatment. There are two methods of the treatment depending on the type of the device which we use during the sessions. The parameters are being controlled by the practitioner. The actual settings are based on the skin type, hair color, localization, and treatment numbers. Generally, we can say that on the face, with the adequate parameters 8-10 sessions are required, the time between the sessions should be 4-6 weeks. On the other hand, if the treated area is localized to other body parts generally 6-8 session is needed, the time between the sessions should be at least 6-8 weeks. In the genital area usually more sessions are required, than on the other parts of the body. Session numbers can vary by person to person, and it is depending on which manufacturer's product we use during the treatment.

Aftercare

To avoid any unpleasant side effects after the procedure, it is important to avoid tanning bed usage for 2 weeks before and after the procedure. Sun protection is also highly recommended for this period along with using emollients on the treated areas.

Adverse effects

Although laser hair removal is generally a safe procedure, it is important that the personnel should be familiar with the indications, contraindications and fine-tuning of the settings. It is important to be able to confidently differentiate between cases in which you prefer to stop treatment to avoid causing unwanted side effects. Ocular injury, more frequently retina injury can occur if eye protection was not adequately used during the procedure. The severity of the injury depends on the duration and amount of energy delivered (42). Infection can occur after almost any laser therapy. Side effects can occur more often if the treated patient has taken photosensitizing medicines. Having deep vein thrombosis in the history or thrombophlebitis or any vascular problems may predispose for a thrombosis (43). The most common side effects are usually mild and transient. After treatment, the treated are may be sensitive and painful for a few days. Most common skin reactions are transient erythema and perifollicular edema (Figure 3-6).

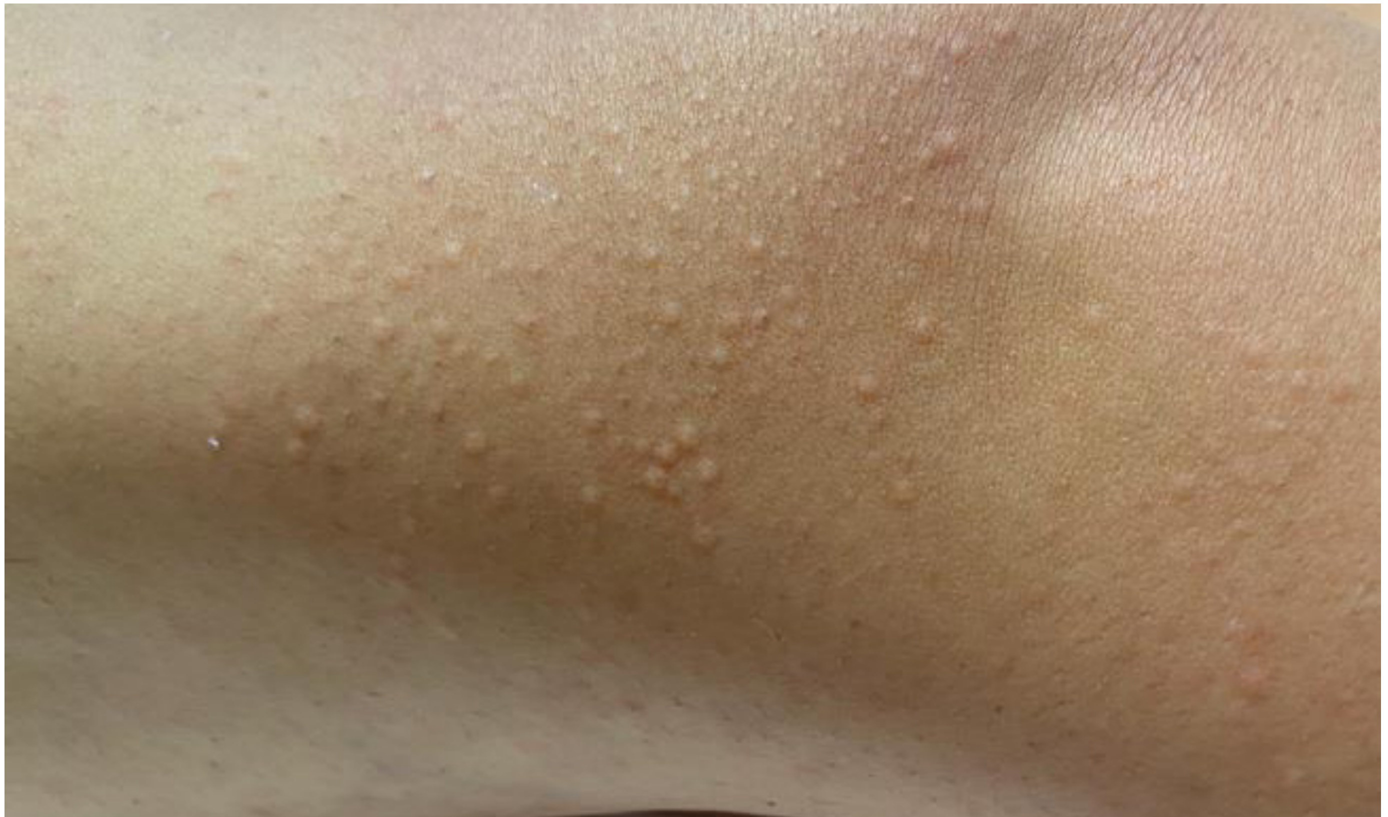

Fig. 3. *Transient erythema and perifollicular edema on the treated area.*

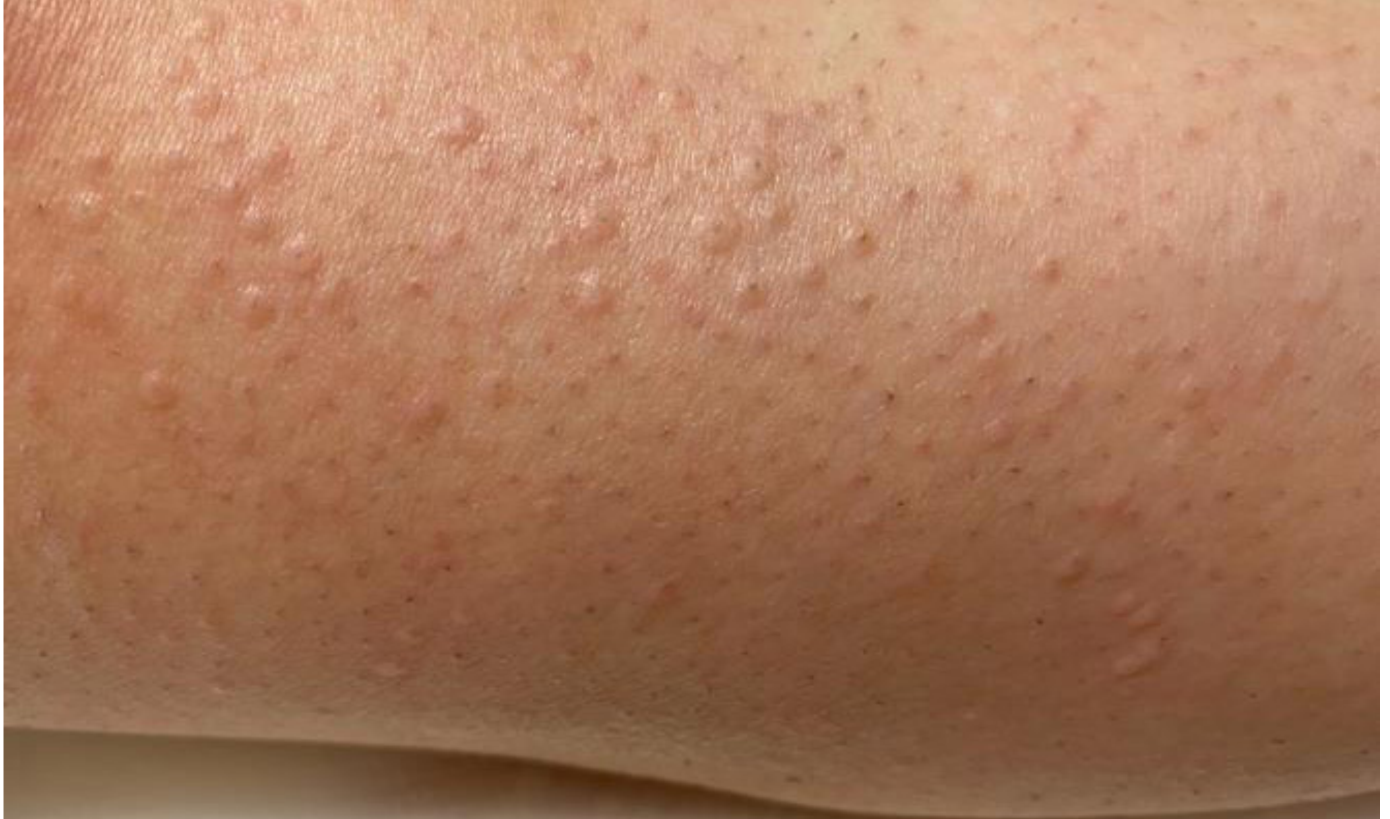

Fig. 4. *kin reaction after the treatment on knee area.*

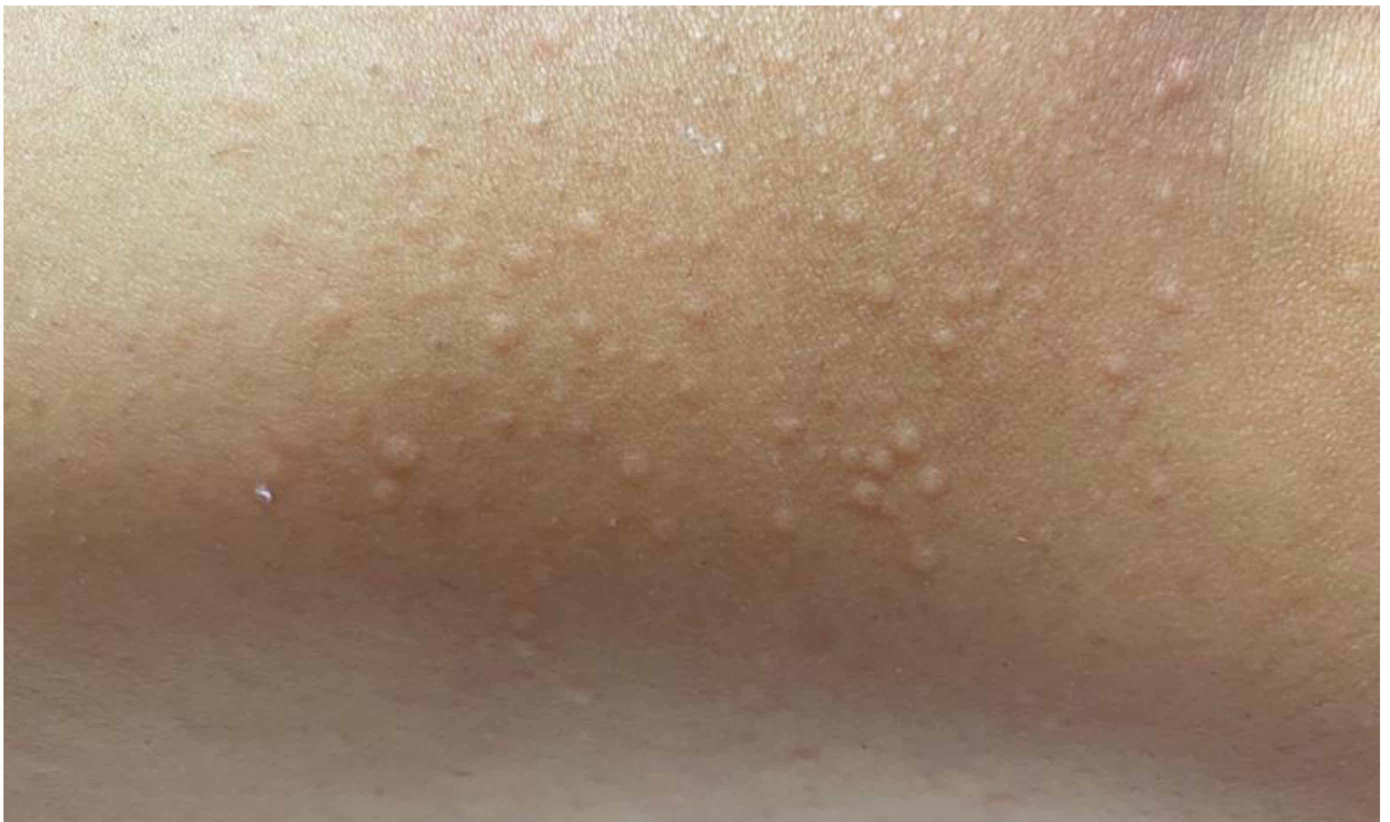

Fig. 5. *Skin reactions after the treatment.*

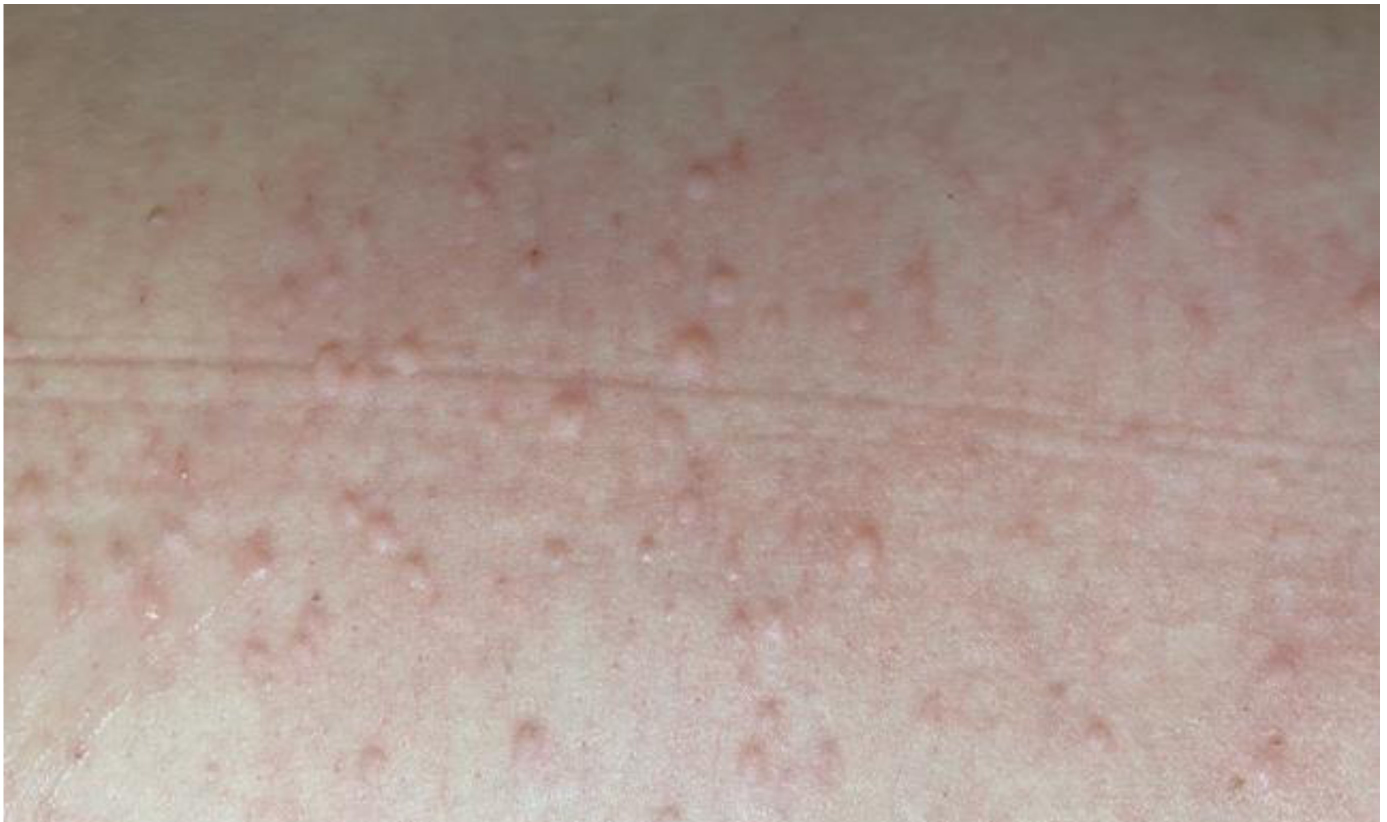

Fig. 6. *Erythema and perifollicular edema on a lighter skin type. Pictures belong to the author and they were taken and published with the written permission of the patients. The pictures were taken right after the treatment. Acute reaction to the treatment is clearly visible. The following reactions are only transient.*

In rare cases, adverse effects can occur like burns, hyperpigmentation, blister, persistent hypopigmentation and permanent scarring (44, 45). Rare adverse effects can also occur including, persistent urticaria, inflammatory and pigmentary changes of preexisting nevi. Ocular damage can cause by the laser if the patient and the practitioner do not wear eye protection during the procedure.

In some cases, infections may occur after laser treatment. Although it is more common after ablative procedures because the barrier function of the skin is impaired, it can also occur after non-ablative treatments. The most common is bacterial infection, which in most cases is caused by Staphylococcus aureus, Pseudomonas aeruginosa and Escherichia coli (46). Laser can also reactivate Herpes Simplex Virus (HSV), so for patients with history of herpes, preventive acyclovir therapy before the sessions is highly recommended (47).

Efficacy

When choosing the right laser and selecting the adequate wavelength and parameters that are suitable and individualized to each patient, diode laser hair removal is the most effective way to reduce hair permanently on the selected areas. Most of the adverse effects and complications are preventable, if the practitioner is well trained, uses the adequate technique and parameters.

Also, successful treatment depends on the patient education, including being aware of taking medicine which may cause photosensitivity and taking the sun avoidance protocol seriously (Table V). In this way, we can reach our goal to get a permanent hair reduction in the most effective and safest way.

	Suitable for				
Wavelength (nm)	hair removal	skin rejuvenation	pigmented lesions	vascular malformations	acne treatment
755	+		+		+
810	+		+		+
Combined laser: 810, 945,1060	+	+			+
1060	+	+		+	+

Table V. *Summarizing the optimal wavelength for treating in different indications with diode laser.*

Cost effectiveness

The faster and more efficiently a machine can handle the treatment, the more cost effective the treatment is. The applied technique, parameters, numbers of the clients, lifetime of the laser headpiece are all influencing the cost and benefits ratio. In terms of costs, the manufacturer must be considered. Purchasing a diode or an Alexandrite laser is much more expensive than an IPL machine that are commonly used in cosmetics. Using laser for hair removal is not only a more effective treatment, but also it is less painful than IPL treatment. It is well known that comfort is a pivotal aspect for the costumers. Efficiency in the long run, convenience and selectivity tilt the balance in the direction of diode lasers in all respects. Due to a market analysis report in 2018, global laser hair removal market was valued at 587,56 million USD (48). The predictions show that 15,9% increasing is expected from 2019 to 2026, regarding to the safety offers by laser devices (Table VI).

Report Attribute	Details
Market size value in 2020	USD 1.76 billion
USD 1.76 billion	USD 1.87 billion
Growth Rate	CARG of 15.9% from 2019 to 2026
Base year for estimation	2018
Historical data	2015-2017
Forecast period	2019-2026

Table VI. *Laser hair removal market report scope (48).*

Discussion

Diode lasers can combine the advantages of other lasers by using different wavelengths. They can provide an effective solution for vascular malformations – e.g. hypertrophic malformations, pigmented lesions cherry angiomas, leg vein, telangiectasias, reticular vessels, and small vein hypertrophy (27, 28). It can be widely used as an antiaging non-invasive procedure, since it showed good results in skin rejuvenation and body contouring (5, 29). Marks, striae, hypertrophic and keloid scars, that cause a significant impact on quality of life, can be treated effectively whit diode lasers (4). Diode lasers were also reported as effective method to remove melasma and solar lentigines (13, 20, 21, 49). In terms of facial rejuvenation, and treating scars or striae ablative treatments are still the most effective options however they may case more severe and more frequent side effects (25). Nevertheless, diode lasers offer the most efficacious and safest procedure for permanent depilating, that makes it gold standard for permanent hair reduction (8, 38). It is very important to note that safety could be only guaranteed when handled by well-trained professionals or medical practitioners to avoid adverse effects. After a trustful examination diode laser provide a convenient safe and effective method to treat variety of problems by using the adequate, effective, and safe laser parameters.

To conclude, the use of diode lasers not only provide an effective and safe solution for laser hair removal but can also deliver a solution to other aesthetic problems. This not only helps to solve physical and aesthetic problems but may also offer a solution to gain back self-confidence. Compared to its competitors, its field of application is constantly expanding, and we can achieve more efficient and convenient treatment in all respects. Based on the growing market of EBD procedures devices with wide fields of indication are more economical. In this sense investing to novel diode lasers with combined multiple wavelength handpieces may be financially rewarding for offices, since they can take advantage of its versatility.

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Hair loss: BDD clinical correlates

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Abstract

Background: Body dysmorphic disorder (BDD) is among the most prevalent psychiatric disorders encountered in dermatological and cosmetic surgery settings. The aim of the study was to assess the prevalence of BDD among patients seeking dermatology treatment for hair loss, by comparing it to healthy controls, and to identify clinical and personality correlates of BDD symptoms. Methods: A total of 228 participants (172 dermatology patients and 56 controls) were administered a validated, clinician-administered BDD scale (BDD YBOCS) accompanied by several self-rated scales measuring state clinical characteristics and personality traits. Results: Of the 172 patients seeking treatment for hair loss, 22.75% had mild, 26.35% moderately severe and 8.98% severe BDD symptomatology. The Hair Loss Group scored significantly higher in the BDD-YBOCS scale than the Control Group (U = 1,797.00, z = -6.65). Significantly higher mean scores of psychopathology and trait anxiety and neuroticism scores were found in the hair-loss dermatology sample compared to the control group. Conclusions: Dermatology patients seeking treatment for hair loss are a diagnostically complex population with diverse needs. Psychological interventions targeting distress or underlying psychopathology may benefit these patients, regardless of concurrent BDD diagnosis.

Introduction

Hair and head hair in particular, have a defining role in the construction of individual and group identity and self-image (1). In contrast, hair loss may represent subjugation, weakness and impotency, and is commonly associated with unattractiveness, low self-esteem, social

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dysfunction, aging, as well as feelings of sadness, depression, and grief (2, 3).

Hair loss is intricately connected to emotional stress. Several studies conducted over the last 40 years have revealed a significant association between stress and hair loss, in that exposure to stressful life events may act as a trigger for various hair-related conditions (4-6). However, underlying psychopathology (7, 8) and personality factors (9) appear to play a crucial role in the development of hair-loss disorders, suggesting that a diathesis-stress model may be in place.

Among the most prevalent psychiatric disorders encountered in dermatological and cosmetic surgery settings is Body Dysmorphic Disorder (BDD) (10-12). Diagnostic criteria for BDD include preoccupation with perceived defects or flaws in appearance that are not observable-or appear slight-to others; during the course, individuals have performed repetitive behaviors such as mirror-checking, excessive grooming, cosmetic procedures and others or repetitive mental acts (13).

Patients with BDD symptoms experience significant psychological distress and impairment in social, occupational, and other areas of functioning (14, 15), while the rates of suicidality among BDD patients are worryingly high, as 27.5% of BDD patients may commit suicide (16, 17). Pathological hair loss concerns are highly prevalent among BDD patients; a recent study showed that the frequency of BDD among patients with complaints of hair loss represented over 29% of the sample (18).

Not only BDD is frequently encountered in dermatology settings, but it also complicates dermatologic treatment outcomes. BDD patients typically show up to dermatology clinics requesting non-psychiatric medical treatments, yet, evidence suggests that these treatments are largely ineffective and produce minimal patient satisfaction (19). Identification of dermatology patients with underlying BDD pathology is, therefore, essential to ensure proper care and improve course and prognosis of the disorder. Unfortunately, research in this subpopulation is scant. Our study aimed to address this critical gap in the literature by investigating prevalence of BDD in a sample of dermatology patients seeking help for hair loss. We hypothesized that, compared to healthy controls, the clinical sample will demonstrate higher rates of BDD symptoms. In addition, BDD symptomatology will be associated with psychiatric and personality factors.

Materials and Methods

Participants

This cross-sectional study was performed in the largest private medical center for hair restoration in Athens. A total of 228 participants were included in the study. Of those, 172 patients seeking treatment for hair loss were grouped in the Hair Loss Group (HLG). Inclusion criteria for the HLG group were (1) age between 18 and 65 years; and (2) absence of major psychiatric diagnosis (e.g., current substance abuse, current or past schizophrenia, bipolar disorder or organic

mental disorder, or those with suicidal intent). Another 54 participants with no hair-loss complaints were included as Control Group (CG). Control group was recruited from Eginition Hospital and 1st Psychiatric Clinic at National and Kapodistrian University of Athens. Inclusion criteria for controls were (1) absence of psychiatric history and/or current psychiatric diagnosis; and (2) age between 18 and 65 years. The study was approved by the local ethics committee and all participants provided their consent to participate in the study and were debriefed at the end. All procedures were conducted according to the principles provided by the Declaration of Helsinki.

Measures

All participants completed a set of questionnaires that included demographic items and assessment of clinical characteristics as presented below.

Body Dysmorphia

Severity of BDD symptoms was measured with the Yale-Brown Obsessive Compulsive Scale Modified for BDD (BDD-YBOCS) (20), a 12-item, semi-structured clinician-administered tool. The questionnaire measures obsessional preoccupations about perceived appearance defects, related repetitive and avoidant behaviors, as well as insight into the condition. Scores range from 0 to 48, with higher scores reflecting greater severity; scores ranging from 32 to 40 on the obsessions and compulsions subscales are considered 'extreme', scores from 24 to 32 are considered 'severe'; 16 to 23 'moderate'; 8 to 15 'mild'; and 0 to 7 'non clinical'. In addition, the Dysmorphic Concern Questionnaire (DCQ) (21) was used to assess appearance concerns. It consists of seven items rated on a 4-point scale (0 = 'not at all' through 3 = 'much more than other people').

General psychopathology

General psychopathology was assessed with the Symptoms Checklist, 90 items revised (SCL-90-R) (22). This is a general psychopathology symptoms scale that has been standardized in the Greek population by Donias et al. (23). For the purposes of our study, the Global Severity Index (GSI) was used.

Depressive symptoms

Symptoms of depression were assessed with the Zung Self-rating Depression Scale (SDS), a 20-item self-report questionnaire that assesses emotional, psychological and somatic symptoms of depression (24). Items are scored on a 4-point Likert scale and total scores range from 20 to 80. A Greek version of the SDS has been validated (25).

State and trait anxiety

Spielberger's State-Trait Anxiety Inventory (STAI) (26) was used to assess state and trait anxiety. STAI has been validated in the Greek population showing excellent psychometric properties (27).

Personality characteristics. Personality traits were assessed with Eysenck Personality Questionnaire (28), a self-report measure of personality consisting of 84 yes-no items. The questionnaire explores three dimensions of personality: psychoticism (P); neuroticism (N); and extraversion (E); it also has one validity scale for lying (L). The questionnaire has been validated by Demetriou (29).

Statistical Analysis

To investigate differences in mean scores across between the HLG and CG groups across the various clinical questionnaires, we divided our HL group into four separate groups based on their scores on the BDD-YBOCS questionnaire: (1) normal range symptoms, (2) mild symptoms, (3) moderately severe, (4) severe symptoms. To assess the association between the group status (HLG or CG) and the BDD-Y BOCKS symptoms severity we used the Pearson's chi-square test.

Data normality we assessed with the Kolmogorov-Smirnov test (Lilliefors correction). For the normally distributed data (only for DCQ) we used One-way ANOVA. For multiple comparisons, post-hoc analysis was applied by using the Tamhane T2 correction, while statistically significant differences were calculated with the Hedge's effect size. For the non-normally distributed data we used a non-parametric Kruskal-Wallis test. Post-hoc analysis was applied using Dunn-Bonferroni correction for multiple comparisons. For the statistically significant differences we calculated the r effect size by using the following equation $r= z/\sqrt{N}$.

To assess the relationship between trait and state psychometric measures with BDD-YBOCS scores, we used Pearson's and Kendall's correlations where appropriate, based on the variance of the data. The variables that had normal variance and significantly correlated with BDD-YBOCS scores were added as predictors into a multiple linear regression model. We considered p value of < 0.05 as an indicator of statistical significance.

Results

Sample Characteristics

Of the 228 total participants, 185 were men (81.5%) and 41 were women (18.1%). The mean age was 31.9±7.57, while mean education was 15.59±2.69 years. The clinical group (hair loss group; HLG) consisted of 172 participants seeking professional treatment of hair loss (160 male and 12 female) in a Hair Treatment Clinic and 54 participants with no hair loss complaints (control group; CG). In Table I we present our sample demographic characteristics.

	HLG	CG	t or χ2	p. value
	M(SD)	M(SD)		
Age	32.69±7.51	30.02±7.44	2.20[a]	.03*
Years of Education	14.85±2.36	16.96±2.73	-5.00[a]	.00***
Gender			60.43[b]	.00***
Male (N)	160	25		
Female (N)	12	29		
M= Mean, S.D.= Standard Deviation, N=frequency; HLG= Clinical Group, CG= Control Group; a t-test; bChi-squared test; *p<.05; ***p<.001.				

Table I. *Demographic characteristics of the sample.*

Of the 172 patients seeking treatment for hair loss, 22.75% scored in the mild symptom range of the BDD Y-BOCS, while 26.35% fell at moderately severe and 8.98% at severe symptom range. Prevalence of BDD symptoms in the CG group were significantly lower, with only 9.26% exhibiting symptoms, and only in the mild range (Table II).

Group	BDD-Y BOCKS symptoms	N (%)
Clinical	Normal	70 (41.92%)
	Mild	38 (22.75%)
	Moderately Severe	44 (26.35%)
	Severe	15 (8.98%)
Control	Normal	49 (90.74%)
	Mild	5 (9.26%)
	Moderately Severe	0 (0%)
	Severe	0 (0%)

Table II. *Mean BDD-YBOCS Score Distribution across Groups.*

The association between the type of group and BDD severity was significant [2(3) = 40.96, p < .0005, Cramer's V = .43]. The Hair Loss Group (HLG; Mdn = 11.00) scored significantly higher in the BDD-YBOCS scale than the Control Group (CG; Mdn = 5.00; U = 1,797.00, z = -6.65, r = -.45).

Group Differences in Clinical Characteristics

Table III presents total score differences between the two groups in questionnaires that measure state clinical characteristics. Below, we present the main findings for each scale.

	(1)	(2)	(3)	(4)	(5)	Main
	hCONTROLS CONTROLS (x̄ ± SD)	HL-NORMAL (x̄ ± SD)	HL-MILD (x̄ ± SD)	HL-MODERATE (x̄ ± SD)	HL-SEVERE (x̄ ± SD)	Effects (*F* or *Z*)
SCL-90 GSI	43±.35(4,5)	.36±.32(3,4,5)	.65±.49(5)	.97±.60 (1, 2)	1.43±.78 (1, 2, 3)	63.62***
SDS	32.57±7.14(2, 3, 4, 5)	40.29±7.66(1, 4,5)	44.58±8.19(1)	48.43±8.91(1, 2)	52.53±11.45(1, 2)	80.55***
STAI-STATE	33.77±11.99(3,4,5)	36.46±7.13(4,5)	40.76±6.78(1)	45.13±10.79(1,2)	50.91±9.94(1,2)	41.21***
DCQ	6.28±3.01(2,3, 4,5)	10.27±4.00(1, 4, 5)	12.14±3.20 (1, 5)	14.84±4.73(1, 2)	19.00±4.15(1, 2, 3)	43.87***
STAI-TRAIT	34.43±9.17 (3,4,5)	38.04±5.90(3,4,5)	43.17±6.68 (1,2)	46.18±8.30 (1,2)	49.64±7.74(1,2)	59.43***
EPQ-P (x̄ ± SD)	4.30±2.54	4.20±2.09	4.31±2.55	5.08±3.06	4.46±2.42	2.08NS
EPQ-N(x̄ ± SD)	8.15±4.09(4, 5)	8.10±4.54(4, 5)	11.17±4.43	12.90±4.63(1, 2)	15.46±3.59(1, 2)	41.96***
EPQ-E(x̄ ± SD)	14.11±3.50	14.84±3.63	13.62±4.12	13.16±3.45	11.28±4.80	10.63*
EPQ-L (x̄ ± SD)	8.56±4.98	10.16±3.65	9.55±3.73	9.42±3.75 N=38	8.82±3.95 N=11	5.34NS

SCL-90 GSI=Global severity Index; SDS= Zung Self-rating Depression Scale; STAI-STATE =State Anxiety; STAI-TRAIT=Trait Anxiety; EPQ-P= Eysenck Personality Questionnaire Psychoticism; EPQ-N= Eysenck Personality Questionnaire Neuroticism; EPQ-E= Eysenck; Personality

Table III. *Multiple Comparisons and Main Effects.*

SCL-90-R Global Severity Index.

GSI differed across all groups [H(4)=63.62, p < .0005]. Post-hoc multiple comparisons showed statistically significant differences between CG and HLG-moderately severe (z = -4.91, p < .0005, r = -0.50) and CG and HLG-severe (z=-5.21, p < .0005, r = -0.63), HLG-normal and HLG-mild symptoms (z=-3.21, p = .013, r = -0.31), HLG-normal and HLG-moderately severe (z = -5.95, p <.0005, r = -0.56), HLG-normal and HLG-severe (z=-5.87, p < .0005, r = -0.64), HLG-mild symptoms and HLG-severe (z=-3.36, p = .008, r = -0.46).

Self-rating Depressive Scale

Mean SDS scores were statistically different among groups [H(4)=80.55, p < .0005]. Post-hoc comparison testing revealed the respective differences: CG and HLG-normal (z = -4.47, p <.0005, r = -0.40), CG and HLG-mild symptoms (z=-5.70, p <.0005, r = -0.59), CG and HLG-moderately severe (z= -7.70, p <.0005, r = -0.78), CG and HLG-severe (z = -6.32, p <.0005, r = -0.76), HLG-normal and HLG-moderately severe (z= -3.88, p = .001, r = -0.37), HLG-normal and HLG-severe (z=-3.61, p = .003, r = -0.40).

State Anxiety

Significant mean score differences were reported across the five groups in State Anxiety measurement [H(4)=41.21, p < .0005]. Post-hoc comparison testing revealed significant differences between CG and HLG-mild symptoms (z= -3.45, p = .0061, r = - -0.38), CG and HLG-moderately severe (z= -4.98, p <.0005, r = -0.52), CG and HLG severe (z=-4.65, p <.0005, r = -0.58), HLG-normal and HLG moderately severe (z= -3.46, p =.005, r = -0.37), HLG-normal and HLG-severe (z= -3.70, p = .002, r = -0.48).

Dysmorphic Concern Questionnaire

DCQ scores differed among groups [F(4,183)=43.87, p < .0005.]. Post-hoc multiple comparisons showed the following differences: CG (6.28±3.01) and HLG-normal (10.27±3.99, p < .0005, Hedge's g = 1.12), CG (6.28±3.01) and HLG-mild symptoms (12.14±3.02, p <.0005, Hedge's g = 1.88), CG (6.28±3.01) and HLG-moderately severe (14.84±4.73, p <.000, Hedge's g = 2.23), CG (6.28±3.01) and HLG-severe (19±4.15, p <.000, Hedge's g = 3.91), HLG-normal (10.27±3.99) and HLG-moderately severe (14.84±4.73, p <.000, Hedge's g = 1.05), HLG-normal (10.27±3.99) and HLG-severe (19±4.15, p <.000, Hedge's g = 2.15), HLG-mild symptoms (12.14±3.02) and HLG-severe (19±4.15, p <.000, Hedge's g = 1.93).

Trait Psychometric Characteristics, trait anxiety

Trait anxiety scores were found to differ across groups [H(4)=59.43, p < .0005]. Post-hoc comparison testing revealed the respective differences: CG and HLG-mild symptoms (z=-4.55, p <.0005, r = -0.50), CG and HLG-moderately severe (z = -6.22, p < .0005, r = -0.65), CG and HLG-severe (z = - 5.06, p < .0005, r = -0.63), HLG-normal and HLG-mild symptoms (z= - 2.88, p = .039, r = -0.33), HLG-normal and HLG-moderately severe (z=-4.38, p <.0005, r = -0.47), HLG-normal and HLG-severe (z=-3.90, p = .001, r= -0.50).

EPQ

While Psychoticism, and Lie subscales' scores did not differ among all five groups (all ps> .05), we found differences in Neuroticism subscale [H(4)=41.96, p < .0005] with the Post-hoc analysis showing differences in HLG-normal and HLG-moderately severe (z= -4.49, p .<0005, r = -0.48),

HLG-normal and HLG-severe (z = -4.33, p <. 0005, r = -0.56), CG and HLG-moderately severe (z= -4.55, p <.0005, r = -0.47), CG and HLG-severe (z= -4.34, p <.005, r = -0.54). Although we found significant effect on Extraversion [H(4)=10.63, p = .031, post-hoc analysis did not reveal any statistically significant difference.

Association between BDD scores and clinical characteristics in the HLG group

Table IV presents the Pearson r correlations between the psychometric measures in the HLG. BDD-YBOCS scores had significant positive strong correlations with SCL-90 GSI, STATE ANXIETY, TRAIT ANXIETY, EPQ-N, SDS and DCQ. Only one moderately negative correlation between BDD-YBOCS and EPQ-E has been found.

	SCL90_GSI	STATE ANXIEYTY	TRAIT ANXIEYTY	EPQ–P	EPQ-N	EPQ-E	EPQ-L	SDS	BDD-YBOCS	DCQ
SCL90_GSI	1	.64**	.70**	.07	.60**	.05	-.01	.58**	.24	.14
STATE ANXIETY	.64**	1	.81**	-.04	.64**	-.12	-.15	.64**	.20	.24
TRAIT ANXIEYTY	.70**	81**	1	.05	.70**	-.12	-.19	.77**	.32*	.36**
EPQ_P	.07	-.04	.05	1	-.16	-.05	.05	-.06	.05	-.04
EPQ_N	.60**	.64**	.70**	-.16	1	-.08	-.01	.67**	.14	.39**
EPQ_E	.05	-.12	-.12	-.05	-.08	1	.12	-.26	-.18	-.11
EPQ_L	-.01	-.15	-.19	.05	-.01	.12	1	-.15	.05	-.16
SDS	.58**	.64**	.77**	-.06	.67**	-.26	-.15	1	.33*	.54**
BDD	.24	.20	.32*	.05	.14	-.18	.05	.33*	1	.30*
DCQ	.14	.24	.36**	-.04	.39**	-.11	-.16	.54**	.30*	1
**. p < 0.01; *. p < 0.05.										

Table IV. *Pearson's correlations in the Clinical Group.*

In order to further assess the relationship between the BDD YBOCS scores and the other psychometric measures we added only the statistically significant correlated measures

into the model (BDD-YBOCS HLG total score = b0 + b1GSI + b2STAI_state + b3STAI_Trait + b4EPQ_N + b5ZUNGsds + b6BodyConcern + b7EPQ_extraversion + error). A total variance of 57.5% was explained by our model R2=.575. The present results indicated that the model was a significant predictor of BDD-YBOCS total score [F(7, 116) = 22.38, p < .001]. Table V presents B coefficients of the present models. GSI, SDS and DCQ significantly contributed to the model.

MODEL for CG	B (unstandardized coefficients)	S.E (standard error)	β (standardized coefficients)
(constant)	-9.759	4.807	
SCL90_GSI	6.221	1.588	.388***
STATE ANXIETY	.111	.083	.126#
TRAIT ANXIETY	.031	.102	.030#
EPQ_N	-.227	.173	-.136#
EPQ_E	-.010	.151	-.005#
SDS	.158	.071	.183*
DCQ	.682	.115	.392***
*p<.05; ***p<.001; # p=NS.			

Table V. *Coefficients of the multiple linear regression model of clinical group.*

To assess the relationship between the BDD-YBOCS scores and all the other psychometric variables among CG we added the significant correlated ones to a regression model (BDD-YBOCS CG total score = b0 + b1 STAI_Trait + b2Jung_SDS+ b3BODYCONCERN + error). This model was not a statistically significant predictor of BDD-YBOCS among CG [F(3, 49) = 2.74, p = .053].

Discussion

Body Dysmorphic Disorder

Our study reported a high prevalence of BDD symptoms in this population. Over 58% of the

sample scored above the normal range of BDD symptoms, while over 35% reported moderately severe and severe symptoms of BDD.

Our results confirm previous reports of the relatively high prevalence of BDD in dermatology patients. While large, nationwide studies estimate point-prevalence of BDD in the general population to be between 1.7% and 3.2 % (30-34) rates of BDD in dermatology patients are significantly higher. For instance, using a validated self-report questionnaire in a sample of 268 treatment-seeking dermatology patients, Phillips et al. (12) reported a prevalence rate of 11.9% of patients. Similarly, Stangier et al. (35) investigated the prevalence of BDD in a sample of 156 dermatological outpatients and reported that 9% of the sample experienced clinically significant body dysmorphic concerns. Comparable rates have been recorded in other studies ranging from 4 to 15% (36).

Prevalence of BDD symptoms in dermatology patients presenting with hair loss complaints may be even higher. In a recent study with 142 patients with hair-loss concerns, over 29% of the sample met criteria for BDD using a validated BDD questionnaire (e.g., BDDQ) (18). A study of 188 patients with BDD seeking psychiatric treatment revealed hair-related concerns in over 50% of the sample (37). Our study extends this research base and confirms the finding of an elevated risk for BDD among dermatology patients seeking treatment for hair-loss.

Furthermore, in our study, the majority of participants seeking treatment for hair loss were men. This is in agreement with previous research showing a gender effect on BDD pathology (18).

Psychiatric comorbidity

We found significantly higher mean scores of psychopathology in the hair-loss dermatology sample compared to the control group. Differences were statistically significant across a number of clinical questionnaires measuring global psychopathology, depressive symptoms, state anxiety, and body dysmorphic concerns.

Our results echo previous research findings suggesting that BDD patients constitute a highly symptomatic group. One study with a sample of 75 outpatients with a BDD diagnosis found that BDD patients had significantly elevated scores for depressive symptoms, anxiety, anger-hostility and somatic symptoms compared to healthy controls (38). Depression and anxiety appears to be quite common among BDD patients (39); in addition, a lifetime history of BDD has been recorded for over 13% of depressed patients (40). Our study further extends preliminary evidence suggesting that psychiatric morbidity is highly present in hair-loss dysmorphia. While previous research on this topic is rather limited, a small study by Radmanesh and colleagues (41) with 50 outpatients with pathological hair loss preoccupations reported as high as 90% prevalence of clinically significant symptoms of depression, anxiety, and obsessive-compulsive disorder. Our findings are also in agreement with the literature on psychiatric morbidity present in hair-loss disorders (42,43). Studies have found that over 66% of patients with alopecia manifest psychiatric comorbidity, most notably adjustment disorders, generalized anxiety disorder and major depression disorder (7).

Personality correlates

As hypothesized, trait anxiety and neuroticism scores were significantly higher in the hair-loss group compared to healthy controls. It has been previously reported that certain personality traits may be more pronounced among BDD patients; for instance, Phillips and McElroy (44) administered the NEO-Five Factor Inventory in 100 BDD patients and reported high neuroticism scores and low extraversion scores, as well as high prevalence of personality disorders are common in, particularly avoidant personality disorder. Personality traits have also been associated with hair loss. Studies suggest that trait anxiety and stress perception constitute risk factors that may influence the onset and exacerbation of hair loss complaints (45). In addition, personality traits, including alexithymia and Friedman's type A personality, may moderate susceptibility to hair loss disorders (46, 47).

Some limitations are worth mentioning. First, the cross-sectional nature of the study does not allow for any causal inferences. Second, men were over-represented in this study. As previously mentioned, this may be indicative of the hair-loss dermatology subpopulation. However, it may limit the generalizability of the findings to women or to other dermatology groups. Furthermore, no formal psychiatric diagnosis of BDD was made. Even though the measure we used has excellent psychometric properties and is frequently used in dermatology settings, the absence of a parallel structured clinical interview may have resulted in biases in the estimation of prevalence of BDD symptoms. Despite the aforementioned limitations, this is one of the few studies conducted in a hair-loss dermatology population, and the first study ever conducted in Greece.

There are important clinical implications that derive from our study findings. Dermatology patients seeking treatment for hair loss comprise a diagnostically complex population. A significant percentage among them appears to present with body dysmorphic symptomatology. For this group of patients, accurate screening and timely psychiatric consultation is of utmost importance, as research evidence overwhelmingly suggests failure of dermatological treatments to alleviate hair loss concerns (19, 48). On the other hand, for patients without clinically significant BDD symptoms who suffer from hair loss, psychological treatments may help alleviate the distress associated with alopecia, address clinical and personality factors that affect the course and prognosis of the condition, and improve treatment satisfaction (2, 8).

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Efficacy and tolerability of an antiperspirant cream in hidradenitis suppurativa patients

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Introduction

Hidradenitis suppurativa (HS) is a chronic, progressive, inflammatory and relapsing skin disease of the follicular unit of the apocrine gland-rich intertriginous areas, that significantly affects the quality of life of an active, young adult population (1-4). The axillary (Fig. 1), inguinal, inframammary, genital areas of the body are the most affected sites and the lesions are characterized by recurrent painful inflamed deep-seated nodules, that result in abscesses and chronic draining sinus tract formation and eventual disfiguring scars (5). Estimates of global prevalence range between 1% and 4%, without racial differences and with a higher incidence in female population. The etiology is still unclear, but the onset of HS is related to a combination of genetic and environmental factors, such as bacterial infection, hormones, smoking, obesity, mechanical and immune factors.

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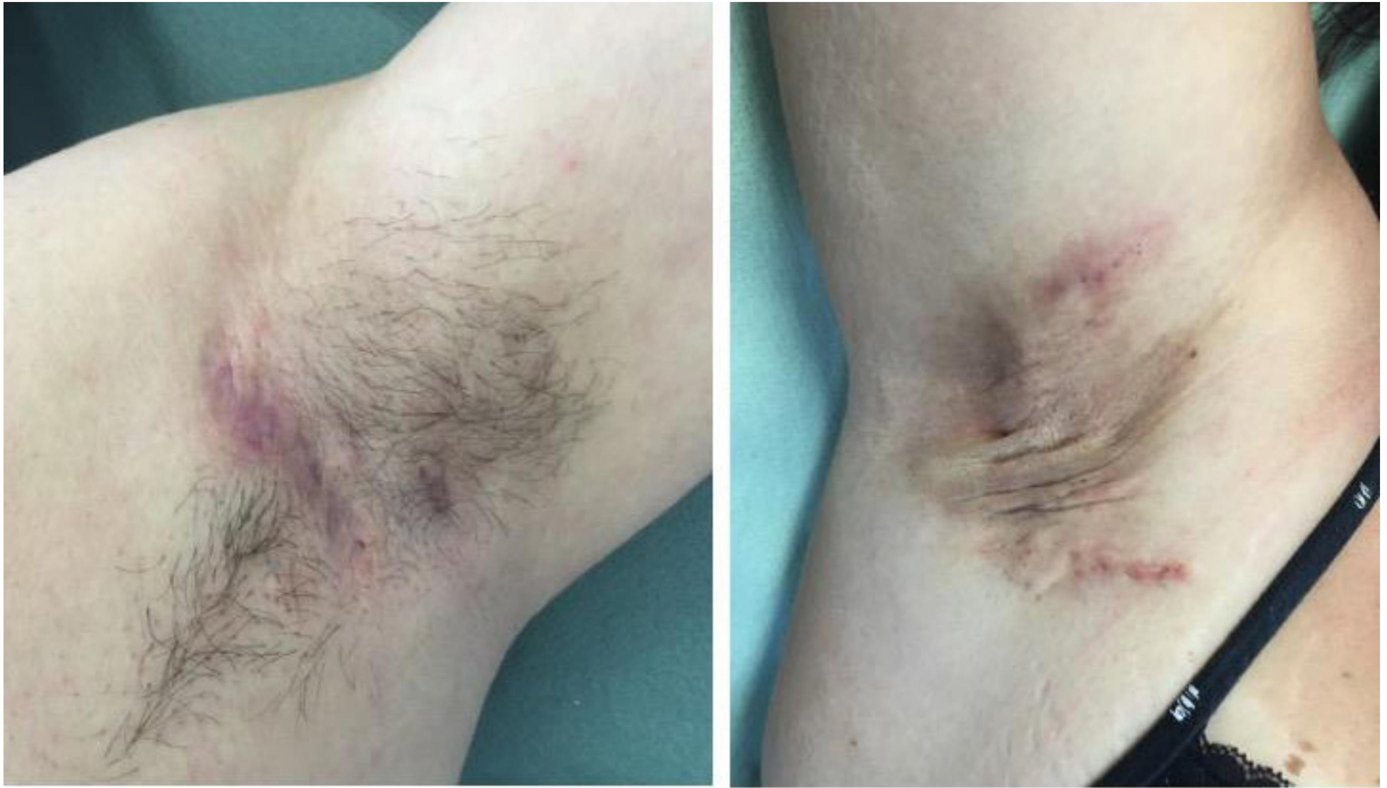

Fig. 1. *Hidradenitis suppurativa involvement of the armpit in 2 patients accepting to apply the tested product: a mild form in the man, and a Hurley 3 stage in the woman.*

Quality of life is seriously compromised by the chronic pain, malodorous abscesses, scarring, and disfigurement. Anxiety and depression are very common in this patient, resulting in a higher risk of suicidal ideation (6). Aesthetic complains worsen the embarrassment and limitations to social, sexual and working life. Often the patient hides the problem even to their relatives and avoids seeking medical care. A mean delay of 7 years from onset to diagnosis is reported (1). Moreover, medical indications for the management of the disease are often in contrast with daily patients' needs, with further compromising of social attendance. In fact, it is generally recommended to avoid deodorants, sweating, rubbing, occlusive or adherent clothing, razor blade shaving (4).

Purpose of our study was to test the efficacy and tolerability of an antiperspirant cream composed of agaricin and chloridol in voluntary patients, with mild to moderate HS.

Materials and methods

An interventional open study was proposed to hidradenitis suppurativa patients consecutively visited at the dermo-cosmetics outpatient ambulatory of the Dermatology Clinic of Cagliari University Hospital, and 15 patients (9 males and 6 females, mean age 26 years) gave consent to recruitment. The study consisted on the daily application for three months of an antiperspirant and anti-odor cream composed of agaricin (a natural substance obtained from Fomes Officinalis, a hard and woody mushroom that grows on the trunk of de larch) and Chlorhydrol,

with antibacterial and antiperspirant properties. Severity of disease was classified following Hurly staging. All patients were under topical and/or systemic treatment following standard HS guidelines. Only required exclusion criteria was the use of other deodorants or antiperspirants during the study period. At the 3-month-follow up a questionnaire was administered to evaluate efficacy, cosmetology pleasantness, and tolerability of the cream. Each item was assigned a score from 0 (minimum value) to 5 (maximum value).

Results

All 15 patients returned to visit after 3 months and reported not having skipped the daily application or used other deodorant products. As regards disease severity (Fig. 2), only 2 cases were considered severe (Hurley 3), the majority being moderate (8 cases) and mild (5 cases).

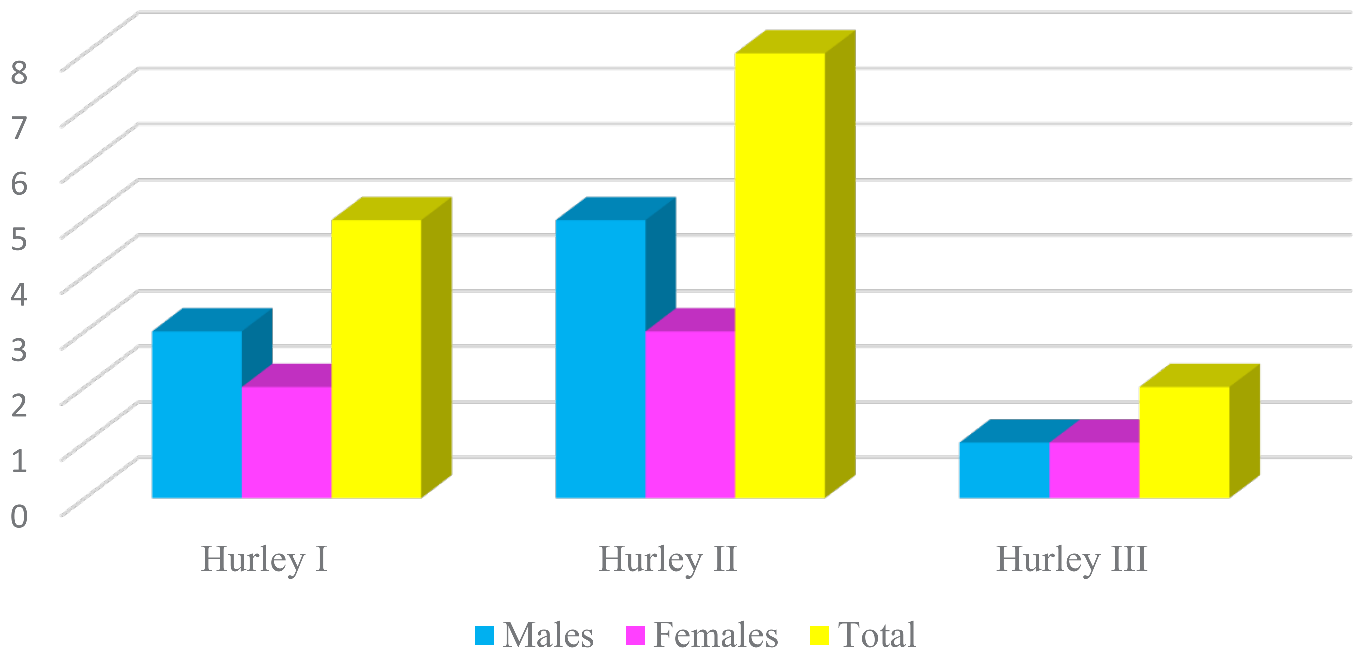

Fig. 2. *Severity of disease following Hurley staging according to sex, and total cases.*

Table I shows the patients' answer to the 9 items investigated at the 3-month-follow-up, regarding efficacy, cosmetic characteristics, and possible unpleasant complaints. The overall effectiveness of the product was maximal for all patients, reducing sweating and improving odor of the axillary regions for a duration of at least 24 hours (Fig. 3). The cosmetology of the tested product, understood as comfort, applicability, pleasantness of texture and fragrance was reported as maximal (Fig. 4).

Items of investigation	0	1	2	3	4	5
Sweating control	0	0	0	0	0	15
Odour Control	0	0	0	0	0	15
Confortable application	0	0	0	0	0	15
Texture	0	0	0	0	0	15
Fragrance	0	0	0	0	0	15
Redness	14	1	0	0	0	0
Burning	15	0	0	0	0	0
Itching	14	1	0	0	0	0
Other discomfort	15	0	0	0	0	0

Table I. *Questionnaire items investigated at the 3-month-follow-up with a 5-point-scale, where 0 is absence of effect and 5 maximum effect of the tested product.*

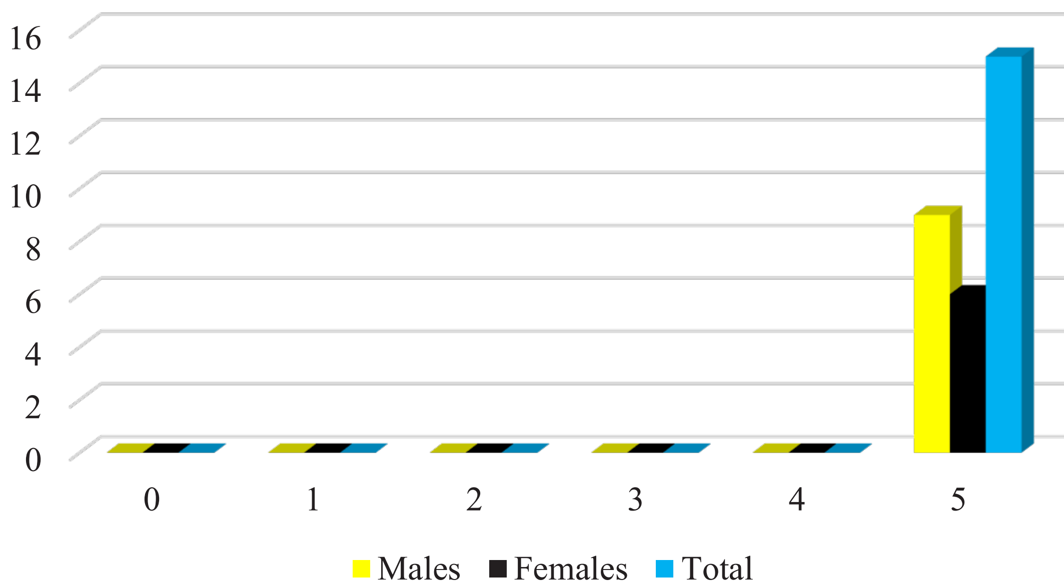

Fig. 3. *Overall rating for the items related with efficacy after24-hour-application.*

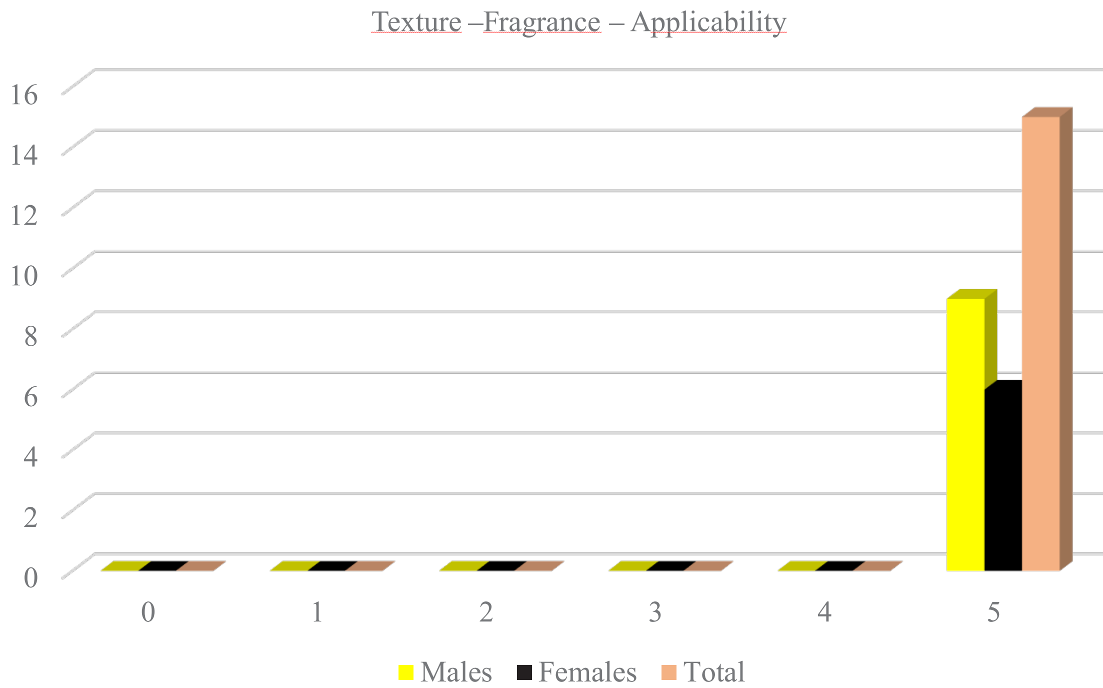

Fig. 4. *Overall rating for the items related to cosmetic pleasantness.*

Finally, tolerability was also optimal, only the patient affected with severe disease reporting mild erythema and itching (Fig. 5), but not limiting the use of the product, as the effects on perspiration and odor were prevalent on mild discomfort.

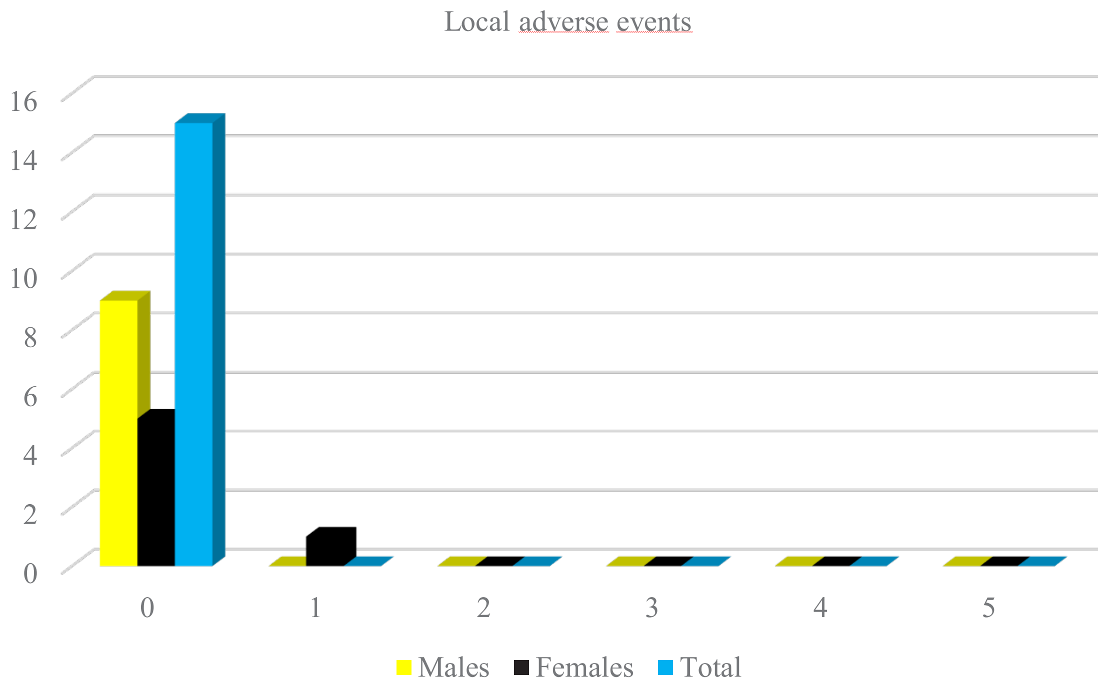

Fig. 4. *Overall rating for the items related to cosmetic pleasantness.*

The general visit confirmed that no patients had signs of disease worsening or irritation related with the tested product application.

Discussion

Hidradenitis suppurativa is a pathology with a high impact on self-esteem, compromising relationship, social and sexual life (1,6) Malodorous intertriginous areas severely impact on normal daily activities, as well as playing sports. For a long time, the convincement that antiperspirants could cause or worsen the disease led to advise the patients not to use them. Of course, certain aggressive commercial products might cause excessive occlusion, interfere with trans-epidermal water loss (TEWL), thereby increasing skin surface moisture, and favoring bacterial proliferation (4). Other potential deleterious impacts of these cosmetics on the HS skin are related to chemical irritant effects on cut, nicked or irritated skin (7,8). It is otherwise noteworthy that sweat represents a pabulum for bacterial proliferation, in particular for those involved in HS, so the use of antiperspirants can be complementary to therapy.

In our study 15 patients affected with mild to moderate hidradenitis suppurativa reported good efficacy and tolerability of an antiperspirant cream applied in the axillary regions every 24 hours for 3 months. No worsening of the underlying disease was observed, and only mild erythema and itching occurred in the only severe case participating in the study, not requiring discontinuation of the application.

No differences were observed between men and women and between the various Hurley stages. Main limitation of the study was the number of patients, and prevalence of mild to moderate disease. However, male's participation was valuable for a major physiological sweating and physical activity in respect to females.

Our study confirms that the use of mild antiperspirants, free of irritating chemicals, can be applied to damaged and inflamed skin, improving a very important cause of discomfort in HS patients.

Conclusions

In a chronic pathology so difficult to treat and with so many psychological and social repercussions, resolution of even an apparently small aesthetic discomfort can make the difference. Antiperspirants should not be avoided for the mis-concept of worsening hidradenitis suppurativa. They are necessary complements to therapy, to improve normal living unmet needs. Of course, tested efficacy and tolerability of the cosmetic products is necessary, suitably selected for such disadvantaged patients.

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A simple technique to minimise post-inflammatory hyperpigmentation with 532 nm nano or picosecond lasers in higher skin types

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key words: *laser, light-based therapy, cosmetology, post-inflammatory hyperpigmentation, PIH*

Letter to the Editor

Dear Editor,

Lasers and light-based therapies are widely used in cosmetic dermatology and have advanced considerably over the years. While the technology has advanced to ensure maximum efficacy and safety; nevertheless, undesired effects or complications still occur (1). A particular undesirable complication in higher Fitzpatrick skin type individuals is the occurrence of post-inflammatory hyperpigmentation (PIH). This occurs particularly with ablative lasers and to a lesser – nevertheless important – extent in the use of nano- or picosecond lasers with the wavelength 532 nm for epidermal pigmentation such as solar lentigines and freckles (2).

Epidermal pigmentation requires a wavelength that reaches the epidermis in sufficient photonic energy that leads to a biological tissue interaction such as melanin photo-oxidation and melanosome disruption or elimination. Typically, a wavelength of 532 nm and 694 nm are used (3). These wavelengths are classified as "short" and reach the epidermis and upper part of the dermis. Wavelengths in the range of 730 to 785 nm might also be used in epidermal pigmentation but in lesions where the chromophore is weak (such as in very light lentigines) the shorter wavelength of 532 nm might be more effective. This however increases the risk of PIH partly due to the increased epidermal melanin absorption with subsequent inflammatory process triggering the release of more melanin, or secondary to the purpuric response often observed with this wavelength leading to

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haemosiderin deposition and PIH.

Lasers interact with the tissue through chromophores and both melanin and haemoglobin (the chromophore used in vascular laser treatments) absorb the 532 nm wavelength4. This is sometimes referred to as "competing chromophores". Given the fact that the pulse durations of this wavelength in both the nano – as well as picosecond domain is too short for any vessel coagulation to take place, the short contact time absorption by the haemoglobin may lead to capillary rupturing (predominantly acoustic effect) with subsequent haemoglobin extravasation and clinical purpura.

A simple technique to circumvent this is to use a glass slide to compress the intended target which will lead to blanching of the underlying small vessels and temporary elimination of the haemoglobin as an active chromophore leaving the melanin to absorb the incoming laser pulse with little to no clinical purpura.It is well known that light will pass through thin glass such as a microscope glass slide. The clinical endpoint is still darkening or frosting of the lentigo or freckle. This technique is simple, cheap, and significantly reduces the risk of PIH with this wavelength.

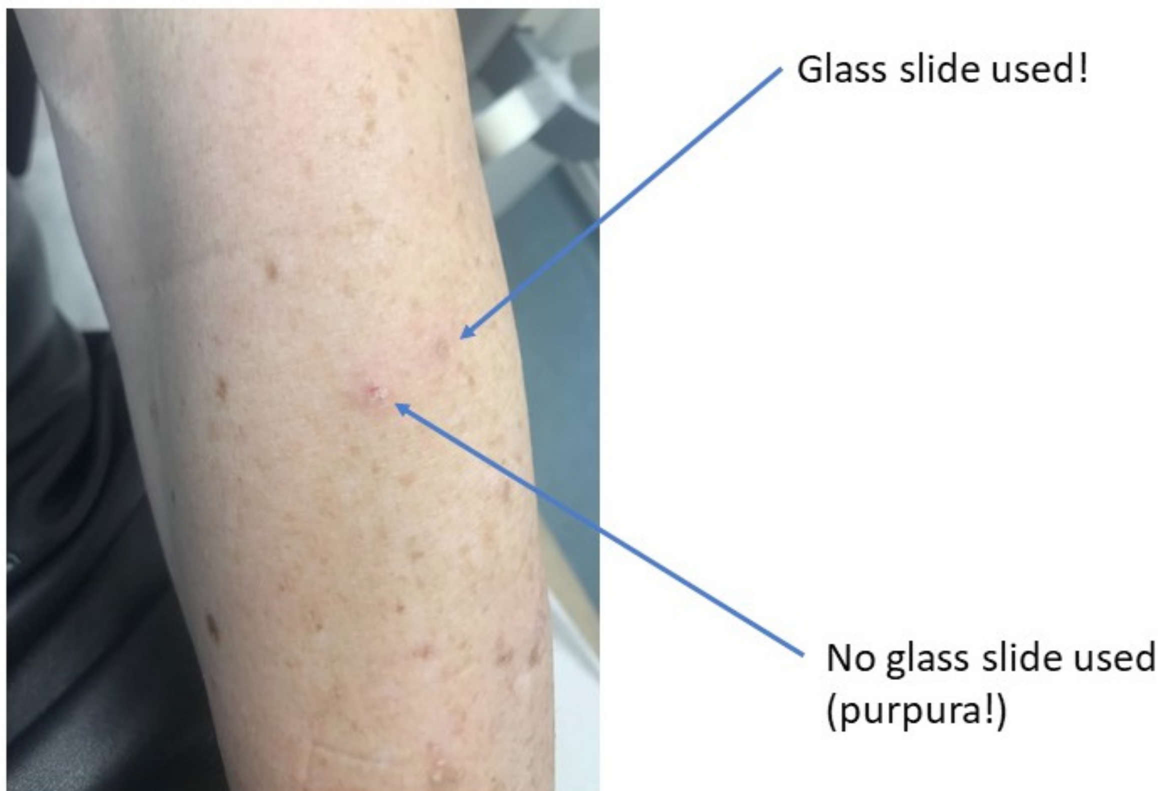

Fig. 1. *Clinical endpoint is still darkening or frosting of the lentigo or freckle.*

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A message to the plastic and dental surgeons regarding anatomical variation of the III trigeminal branch. Analysis of literature, diagnostic-radiological correlations and case reports

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key words: *Anatomical variation, trigeminal nerve, orofacial pain, III trigeminal branch, maxillofacial surgery*

Abstract

Background. "Pain" is one of the defense mechanisms of the body and fundamental for life support. However, the orofacial pain of trigeminal neuralgia plays no role in the body's defense mechanisms and requires therapeutic intervention. Methods. In our study we analyzed how the anatomical variations of the III trigeminal branch should be considered in case of persistence of painful symptoms after maxillofacial and dental surgery treatments. Results. In our case reports we have shown how a careful medical history and a thorough radiological technique can highlight the anatomical variations of the III trigeminal branch. Conclusion. The indication for a radiological study of the anatomical variations of the III branch of the trigeminal nerve is mainly supported by the request to perform any intervention in order to avoid complications in case of double or triple nerve canal or even motor damage at the level of the temporal and mandibular joint.

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Introduction

Anatomical variation can be defined as the morphology of a particular structure that deviates of anatomical configuration observed in most individuals (Turney BW, Bergman RA). The anatomical variants, albeit in their complexity, are part of a normal body organism, contrary to congenital anomalies.

During organogenesis, the positioning of the anatomical structures takes place, which conditions the relative relationships between the viscera, the origin and course of the blood and lymphatic vessels (Fig. 1).

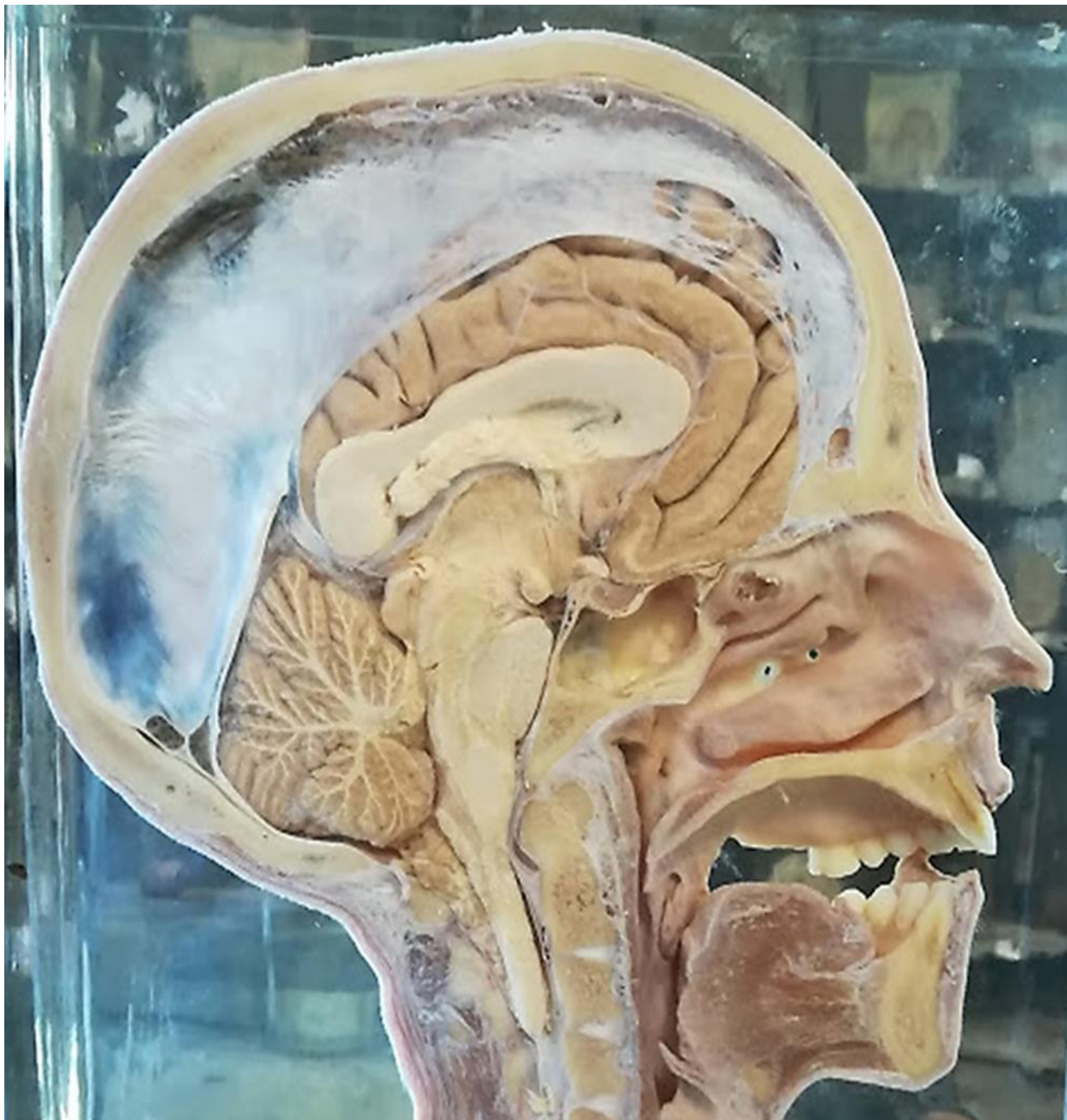

Fig. 1. *Morelli Anatomical Museum of the C. Forlanini Hospital in Rome. Formalin preparation of the sagittal section of the head.*

These modifications are the result of complicated processes of growth, rotation and migration that occur during the stages of embryonic and fetal development and in the context of biological

variability there are anatomical morphological situations which, if not hypothesized, can generate clinical problems.

If the surgeon does not consider the possibility of the presence of anatomical variants, he can produce damages that cannot be resolved in a subsequent surgical time and a knowledge of any anatomical anomalies and a correct surgical strategy in most cases avoids irreversible damage.

Our goal was to treat the anatomical variants of the III trigeminal branch as a whole with particular attention to the mandibular canal and to critically report the surgical experience and a subsequent discussion will be based on how the surgeon can and should prudently adhere to a correct preoperative evaluation of the morphological anatomy.

The final goal is therefore to update the knowledge of the basic disciplines making them easily usable.

Materials and methods

The need to deepen the knowledge on the anatomical variants of the III trigeminal branch is important not only for the purpose of collecting anthropometric data, but above all for improving surgical protocols and understanding how and why sometimes preliminary guidelines for the surgical technique do not produce results expected.

In a very recent publication of the year 2019 Ghatak et al. observed that about 20% of the population present anatomical variations of the trigeminal nerve and how they are inserted exclusively in the III branch or in the mandibular nerve and its branches, but not in the I branch or in the II branch.

The same authors reported some anatomical variations which include:

- Anatomical variations of the inferior alveolar nerve
- Anatomical variations of the lingual nerve
- Anatomical variations of the buccal nerve
- Anatomical variations of the auricular and temporal nerves
- Cervical plexus: additional innervation of the mandibular region.

The inferior alveolar nerve can provide more extraosseous branches before entering the mandibular canal and within the bony canal it can also provide rise to more intraosseous branches. It may also show anatomical variations in its relationship to the maxillary artery.

The lingual nerve has been studied quantitatively in its anatomical relationship with the region of the third molar. Studies report that the mean horizontal distance of the nerve from the base of the tongue ranges from 0.58 to 3.45 mm. The mean vertical distance of the lingual nerve below the alveolar ridge is between 2.28 and 8.32 mm. This is important for oral surgery, for example in the extraction of the tooth called third molar, in the management of mandibular trauma, in periodontal procedures and in the excision of neoplastic lesions.

The buccal nerve can innervate the mandibular molar teeth by entering the alveolar bone through the retromolar foramen. This could be responsible for a failure of the defined local anesthesia of traditional alveolar nerve block.

The auriculotemporal nerve has been described to have a connection with the inferior alveolar nerve. In regional anesthesia, this compromises

the effectiveness of the inferior alveolar nerve block.

The cervical plexus can provide to additional nerve fibers that provide additional innervation to the mandibular area.

The cervical plexus gives rise to the large auricular nerve which provides afferent innervation to the mastoid process, the parotid gland, and the external ear. In cases of third molar extractions in which conventional anesthesia was unsuccessful, permanent anesthesia of the great auricular nerve has been reported. This suggests that the great auricular nerve is involved in the innervation of the angle of the mandible and a separate infiltration of the nerve may therefore be necessary in these cases to achieve complete anesthesia of the mandibular region.

It has been described how during maxillofacial or dental surgery of the lower dental arch it can be refractory to anesthesia when there is an anatomic variation of the III trigeminal branch (1, 2) and there have been reports in which this variant prevented the correct positioning of an implant with the need for its subsequent removal (3). The mandibular canal is a bilateral structure that originates in the mandibular foramen and runs longitudinally along the mandible towards the medial face of the horizontal branch, placing itself in relation in its course with the roots of the molars and lower premolars and ending in the mental foramen (4, 5, 6). The mandibular canal contains (Fig. 2, 3, 4) the inferior alveolar vascular-nerve bundle (7) and the mandibular canal is responsible for somatosensory activity and arteriovenous perfusion of the mandibular teeth, interdental papilla, lower lip and alveolar bone tissue (8, 9).

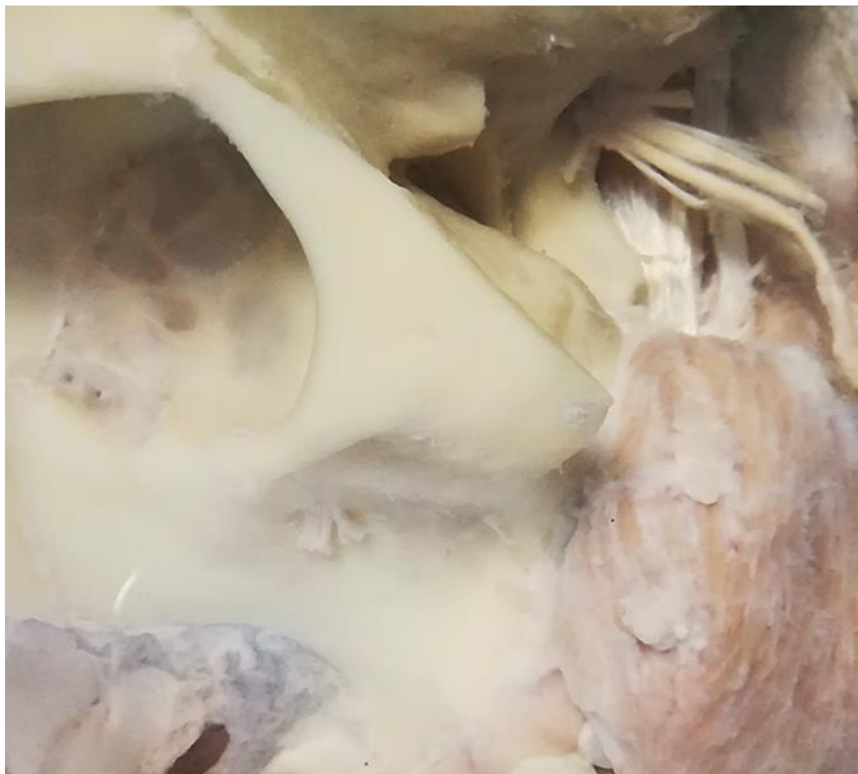

Fig. 2. *Morelli Anatomical Museum of the C. Forlanini Hospital in Rome. Anatomical dissection of the III trigeminal branch showing the Oval Forum.*

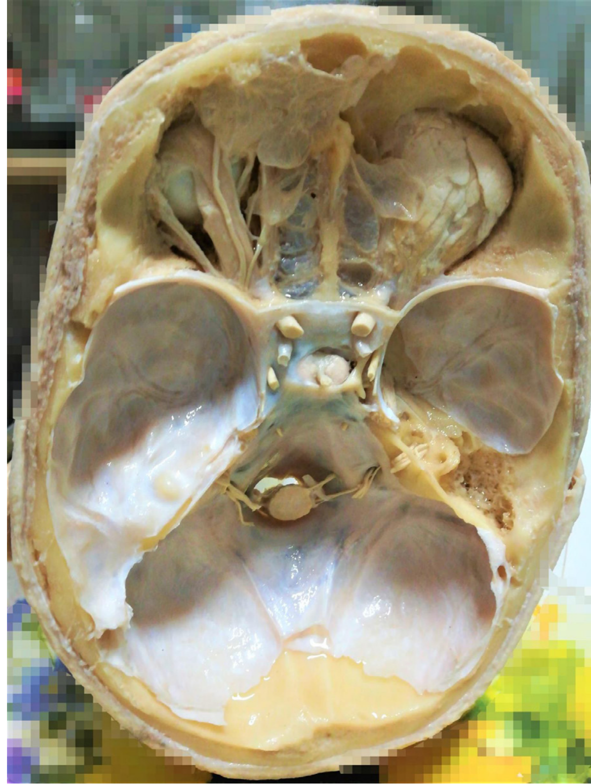

Fig. 3. *Morelli Anatomical Museum of the C. Forlanini Hospital in Rome. Prepared in formalin which highlights the skull base with the cranial fossae and, on the right side, the structures of the petrous rock.*

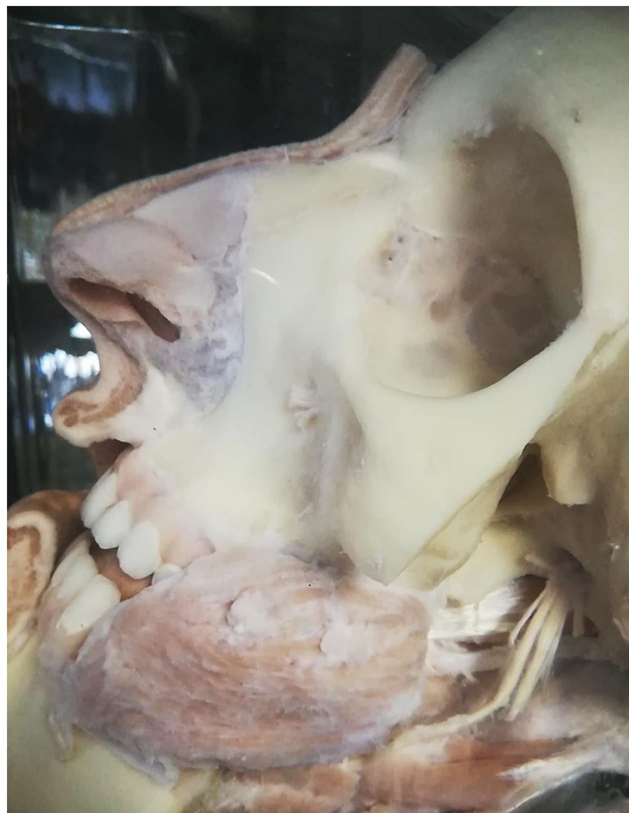

Fig. 4. *Morelli Anatomical Museum of the C. Forlanini Hospital in Rome. Prepared for cadaver dissection of the Oval Hole of an adult male.*

The formation of the anatomical variant of a bifid or trifid mandibular canal occurs during and through embryogenesis. Around the seventh week of gestation and during embryonic development, the nerve occurs in three independent nerve branches surrounded by bone tissue attached to the inferior alveolar nerve (10, 11) and if during embryogenesis one or more of these nerve branches are formed is incomplete, ossification of the surrounding tissue can be created with the formation of an accessory mandibular canal (10-12). Depending on its length, one or more accessory foramen can also form, such as the accessory mental foramen (13) and the vestibular and the lingual foramen can coexist in ossification or in a retromolar position (14).

Four anatomical variant types of bifid mandibular canal are described which are grouped into a single classification: type I or retromolar, type II or dental, type III or anterior and type IV or buccolingual (15, 9), and classified according to anatomical position and configuration (16). The anatomical variant of the retromolar bifid mandibular canal or type I ends in a retromolar foramen and consists of a branch that extends from the main mandibular canal under the third molar (17) and in this variant there is a bundle inside the canal neurovascular that innervates the buccinator muscle, the retromolar trigonum, the lower third molar, the bone and mucosa of that anatomical territory (15, 18, 19).

Before performing surgical treatments such as mandibular osteotomies, dental implants and extractions of the third molar, it is necessary to be aware of the possible presence of this type of variant, its position and its morphology (20-22). In fact, the incidence of damage to the inferior alveolar nerve complained by patients during dental procedures can vary between 0.4 and 13.4% (23).

A rare anatomical variation in which the myoid nerve emerged from the lingual nerve near the submandibular duct has been described during a routine oral dissection. The lingual nerve is a branch of the mandibular division of the trigeminal nerve. It descends medially and anteriorly to the inferior alveolar nerve through the pterygo-mandibular space, flows near the lingual plate and lingual crest of the lower third molar, and supplies sensory fibers to the anterior two thirds of the tongue. During the extraction of the third molar this branch of anatomical variant may be occasionally injured with possible paralytic results affecting the tongue. In fact, the inferior alveolar nerve provides to the mylohyoid nerve just before entering the mandibular foramen and innervates the mylohyoid muscle and the anterior part of the digastric muscle (24). It is also possible that there may also be discrepancies in the terminal distribution of this nerve (25).

When painful symptoms are present after or during a surgical act maxillo-facial surgery or dental procedures should be considered suspect and the hypothesis of an anatomical variation of the third branch of the trigeminal with the need for further investigation with imaging techniques to verify the suspicion of a mandibular canal bifid or trifid (26). Radiological data of anatomical anomalies can be collected by studying images obtained with different methods and depending on the method we will have a greater resolution and precision in defining the anatomical structure. With the simpler method of X-rays, an

incidence of the bifid mandibular canal of about 1% was demonstrated (27), while the subsequent data collected with CT allowed to observe 20% of false negatives.
Cone Beam Dental Computed Tomography has shown that the prevalence of a bifid mandibular canal and its four variants is higher than that observed with plain radiography and CT (9), while cadaver dissection studies have shown that the incidence of anatomical changes which include bifid mandibular canals and trifid mandibular canals range from 0.08% to 65.0% (28). The type I defined as retromolar or type I consists of the presence of a canal that ends in a retromolar foramen or a branch that extends from the main mandibular canal to below the third molar (17). Within this anatomical variant of the mandibular canal there is the presence of a neurovascular bundle that innervates the buccinator muscle, the retromolar trigone, the molars of the lower third, the bone and mucous membrane of that anatomical territory (17-19).

Case reports

As part of our clinical experience, we have found the following cases of anatomical variation of the third trigeminal branch.

Case 1. The patient, a 49-year-old female, complained of persistent pain following dental treatment and had a thin bifurcation of the mandibular canal below the tooth being treated (Fig. 5, 6, 7).

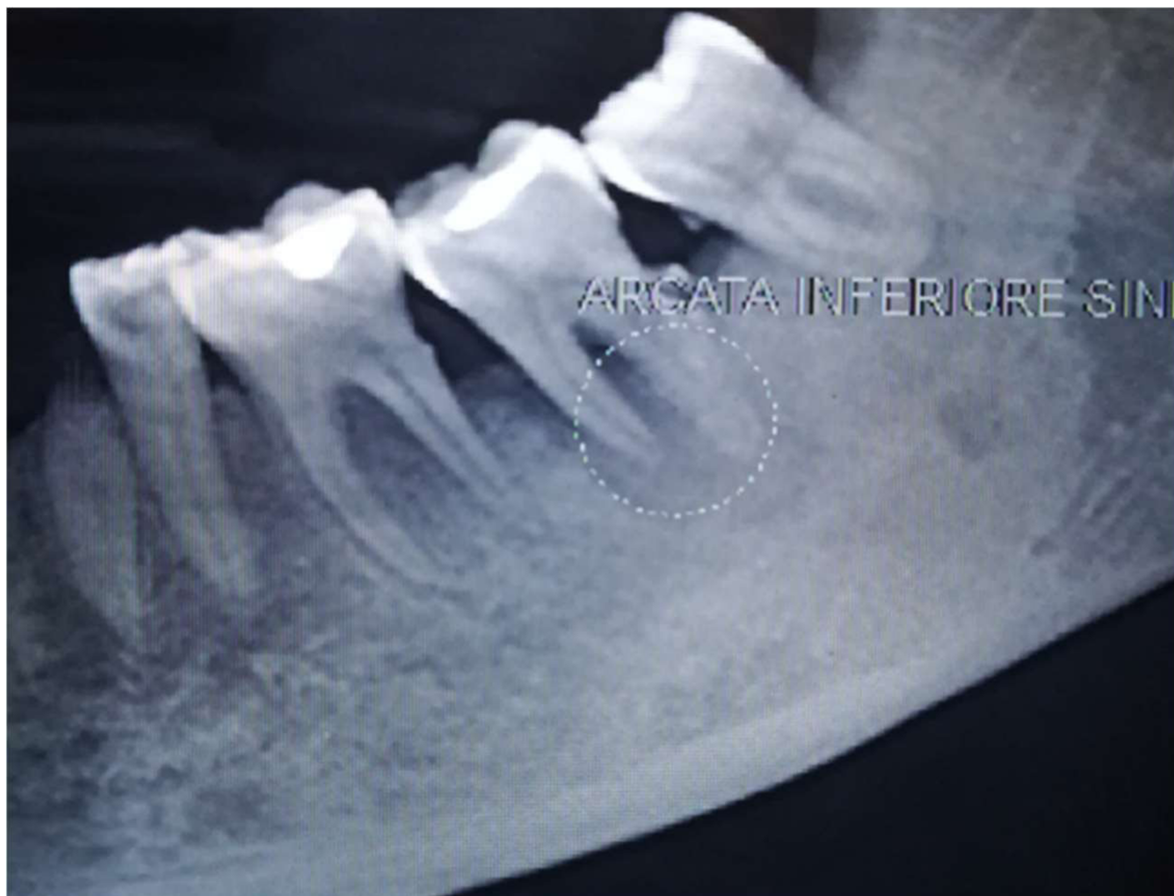

Fig. 5. *X-ray of lower arch.*

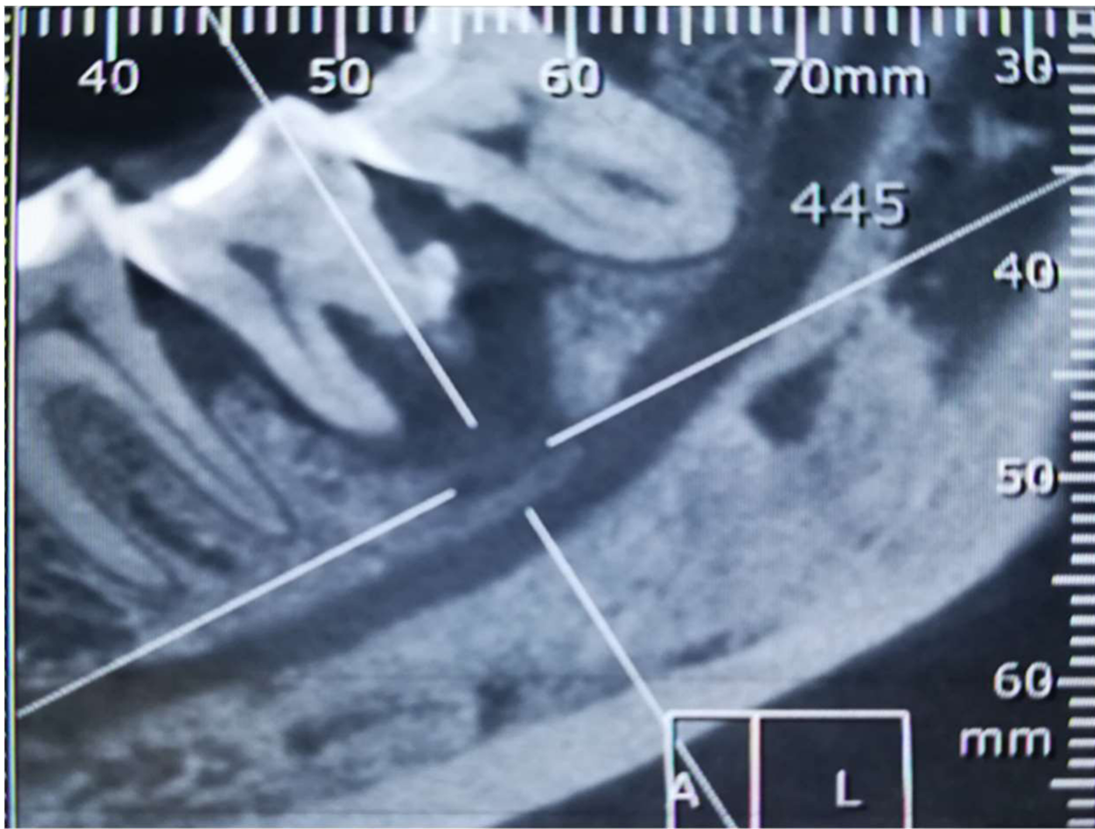

Fig. 6.*Cone beam computed tomography (CBCT) showing the anatomical variation.*

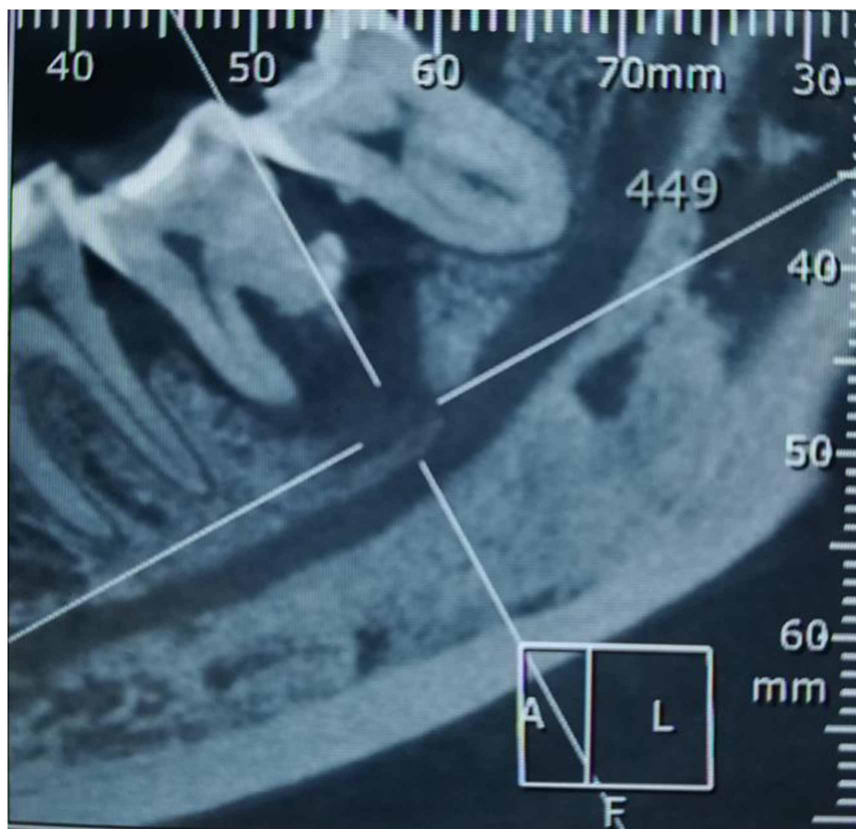

Fig. 7. *Enlargement of previous image.*

Case 2. The patient, male and 30 years old, complained of trigeminal pain in the territory of the III branch resistant to medical therapy (Fig. 8, 9).

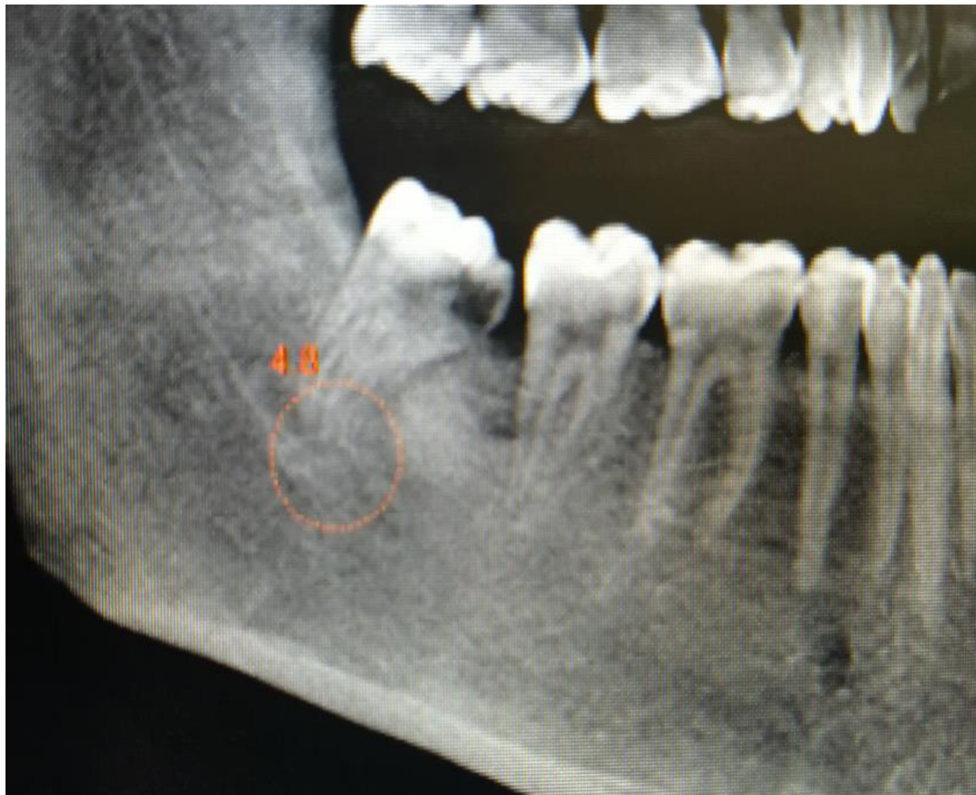

Fig. 8. *X-ray of lower arch.*

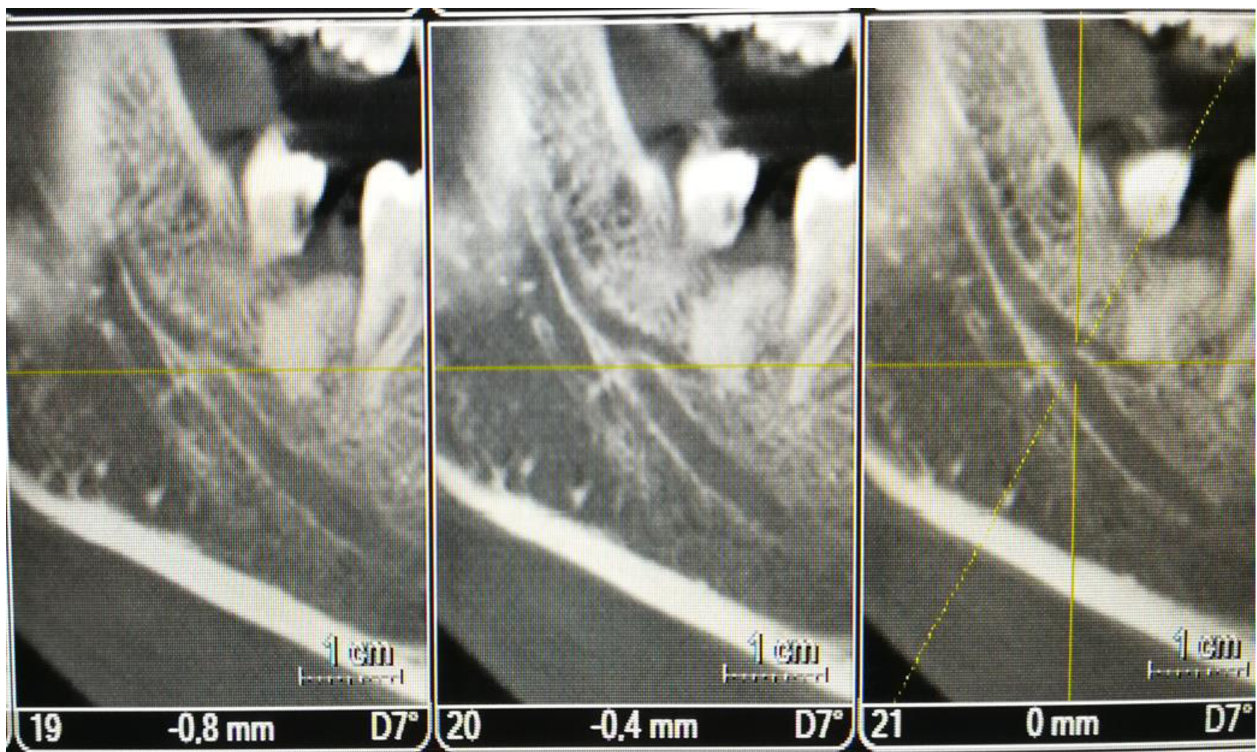

Fig. 9. *Cone beam computed tomography (CBCT) showing the anatomical variation of the bifid mandibular.*

Case 3. A 57-year-old woman who, due to the need to undergo a dental implant, underwent a pre-operative radiological study. The study showed the presence of extra mandibular canal (Fig. 10, 11).

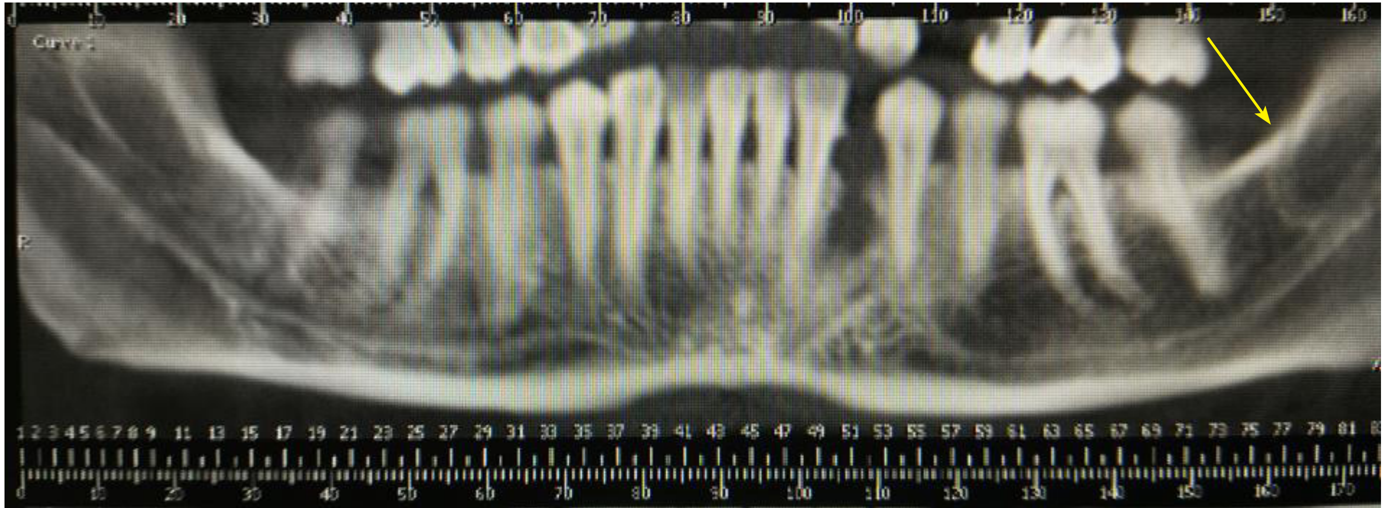

Fig. 10. *Bifid mandibular canal.*

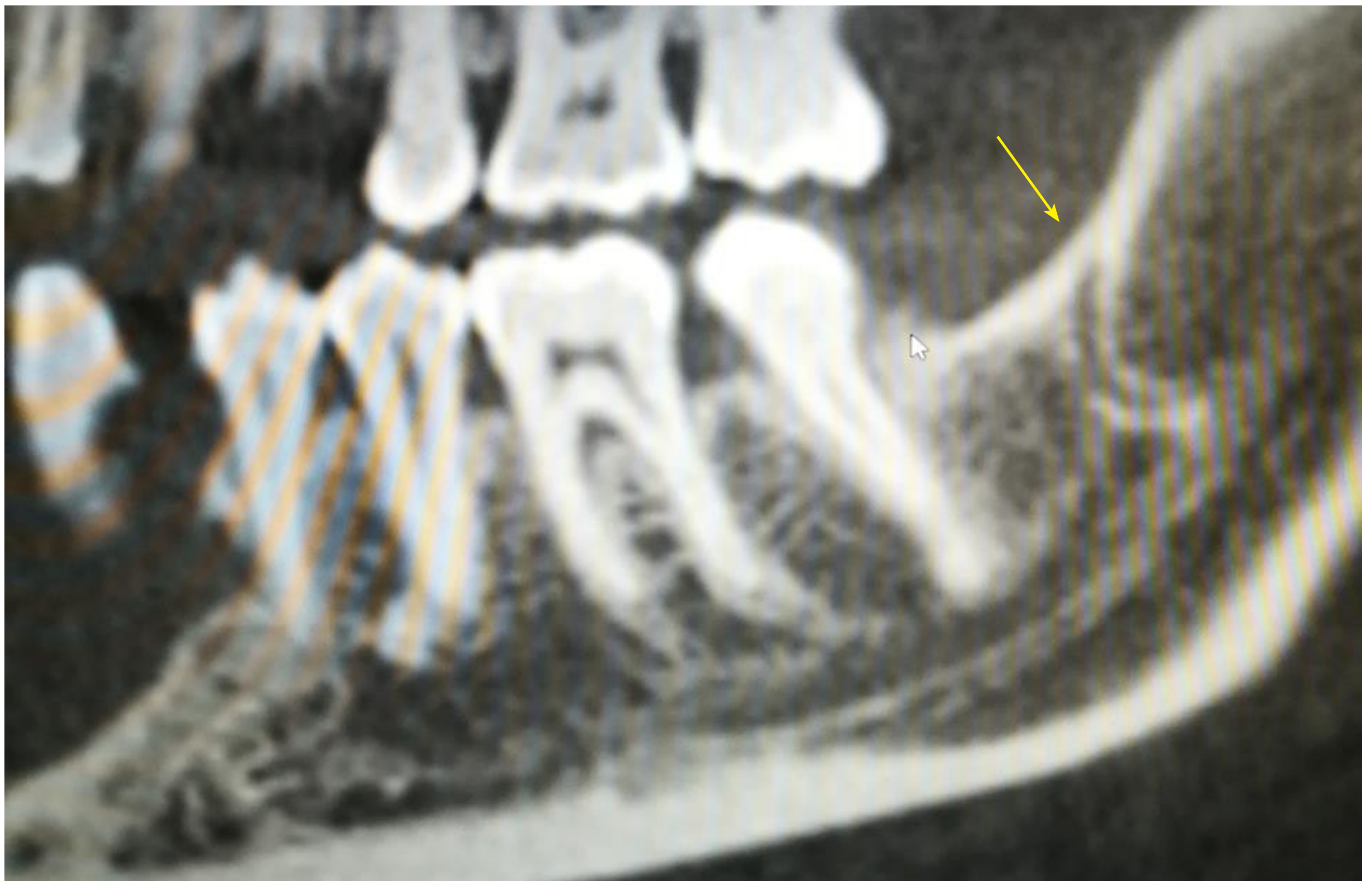

Fig. 11. *Enlargement of previous image.*

Clinical-radiological observation of the cases on display offers us the opportunity to reiterate the importance of anatomical variations in addition to the critical discussion of surgical techniques suitable for dealing with similar occurrences.

Discussion

When pain worsening occurs following medically resistant surgery, a bifid or trifid anatomic variant of the mandibular canal can be assumed. Pain is one of the body's defense mechanisms. However, orofacial trigeminal pain plays no role in the body's defense mechanisms and requires therapeutic intervention. Bifid or triffid mandibular canals may be present as a change in normal anatomy with an incidence ranging from 0.08% to 65.0% (28). As can be readily understood these anatomical variations are of significant clinical importance. During a dental surgery it may happen that a loco-regional anesthesia is incomplete especially when two mandibular foramina are involved while in more complex cases or during mandibular surgery a second or even a third neurovascular bundle can be damaged causing paresthesia due to amputation, development of a neuroma, or bleeding (28).

Anatomical variations of the third trigeminal branch, involving the mandible through the accessory mandibular canals and its foramina, can cause complications during surgical procedures if not identified correctly and over time, as sympathetic and parasympathetic autonomic nerve fibers travel with different branches of the trigeminal nerve to reach organs and tissues of their distribution territory. The mandibular nerve plays a fundamental role in the anesthesia of maxillofacial and oral surgery. Changes in the inferior alveolar nerve are a concern for surgical and dental practice, and anatomical changes in the inferior alveolar nerve can simulate the presence of keratocystic odontogenic tumors.

Major surgical concerns include the location of infratemporal depression where mandibular nerve compression is frequent. Infratemporal depression is one of the most difficult regions to access surgically (1). To lower the risk of surgical complications such as bleeding, dysesthesia, swelling and pain it is important to perform instrumental examinations and a CBCT to detect and identify anatomical variants (7, 29), which have led to significant improvements in surgical procedures with improved clinical course (9, 30). Generally, both canals and foramina are symmetrical (31, 32) and there is also a variation in the number (33) although a rare event (34, 35).

The accessory mental foramen is a rare anatomic variant with a prevalence ranging from 1.4 to 10%. To avoid neurovascular complications, particular attention must also be paid to the possible presence of one or more accessory mental foramina during surgical procedures involving the mandible.

Careful surgical dissection must be performed in the region so that its presence can be detected and thus avoid the onset of a sensorineural disorder or hemorrhage.

The prevalence of a bifid mandibular canal can

be variable and the method of image acquisition influences the determination (36) as well as a careful check of the image quality (37). The first data of the patients who were examined with the X-ray method (27, 38). From the acquired images it was possible to calculate how the incidence of this variation of the mandibular canal is about 1% (27, 39, 40, 41). There was an increase in the positive rate of change through the image resolution technique using cone beam computed tomography (CBCT) (9). Cone Beam Computed Tomography (CBCT) has in fact detected a prevalence of 65% of the bifid mandibular canal of which type I represents as much as 29.8%. Even compared to CT, CBCT has been shown to be significantly more effective in detecting canal bifidity. In fact, in that study it was shown that CT was unable to highlight 4 of the 19 bifid channels detected by CBCT in the images revealing a prevalence of 10.2%, with a major relapse for type I with 52.5% of cases (43) and type I is the most frequent with a percentage of 71.3% of cases (43).

Through CBCT it is possible to detect many more cases of anatomical variations than the simpler radiological panoramic techniques since it is possible to detect many accessory canals, narrow and thin bifurcations. Using this type of radiological survey (CBCT) the percentage varies in any case for the size of the sample, for the calibration of the images, for the criteria used to classify the variation, for the examiners of the images and for the ethnic groups of the subjects studied, but the percentage does not vary significantly if age and gender are considered (15, 27, 44). The mean diameter of the bifid mandibular canal studied through CBTC images was established to be between 1.21 mm and 2.2 mm (43), with an average accessory canal length of 14.97 mm and 16 mm for the type I (42) while the CT images reported average diameters between 1 and 2 mm and a length of 15 mm of the accessory canal (4).

Medical doctors, surgeons and dentists who are unable to obtain complete anesthesia of the mandibular nerve must suspect the presence of an anatomical variant. Many branches of the mandibular nerve are responsible for controlling the motion of the temporal mandibular joint and the auricular temporal nerve can be damaged during surgery, both on the temporal mandibular joint and for dental procedures, due to its interconnections with the inferior alveolar nerve in a statistically significant percentage of cases. This condition can cause paresthesia of the pinna and the ear region (9). For example, ear pain due to irradiation along the auricular temporal nerve has been documented in a patient with a lingual prisoner. Tensor eardrum syndrome causes ear pain, local sensation of floating or fullness of the ear. Increased activity of the eardrum tensor muscle develops in many people with hyperacusis as part of the response to certain sounds. The risk of injury to the marginal mandibular nerve is also due to a high anatomic variability. It is often represented by one or two branches. Its origin is described at the apex of the parotid and above the lower corner of the mandible although in its course at least one branch is often found under the lower corner of the mandible. Its most frequent anastomosis is with the buccal branch of the facial nerve.

Primary trigeminal neuralgia is commonly attributed clinically to mandibular ramus distress

and can be treated surgically by dissecting the sensory root. Secondary trigeminal neuralgia is due to the main neurological diseases such as multiple sclerosis or tumors with possible involvement of the mandibular nerve branches is subject to a clinical unexpected due to the numerous possible anatomical variations.

Conclusions

The knowledge of the anatomical variations guides us on the suitable surgical technique to obtain the best clinical result with the lowest risk of complications which, in some cases, are functionally serious and sometimes irreversible. This work, synthesis of a bibliographic research and exposure of clinical experience of case reports, leads us to some statements reported below.

Anatomical variants are not exceptional events and sometimes, if a correct surgical technique is not adopted that allows for exploration significant and irreversible damage is incurred. Today there are not many published studies on the anatomical variations of the III branch and the clinical cases of bilateral type I canals. This can be explained by the low prevalence and because most of the existing studies are based on radiological orthopanoramics. It seems useful to carry out a larger number of CBCT studies that easily determine the prevalence and morphometric indicators of accessory channels and their different types in Latin populations, since most of the reported studies are conducted in Asian or North American populations. Of all the alternative imaging methods available to clinicians CBCT appears to be the best for evaluating an accessory mandibular canal as it provides a better view of adjacent structures, allowing for the correct assessment of its morphology. This is very important for planning complex treatments such as dental implants and third molar extraction. It is therefore recommended that surgical procedures of this type in the mandibular area be performed by establishing the exact position and possible anatomical variants. The surgical technique (access and dissection plans) is fundamental in strategic terms to obtain the best possible exposure of the tissues to be respected, having in mind the structures to be preserved and considering all the possible morphological variants.

The preoperative diagnosis of the variants is difficult and radiological examinations are often very specific, thus increasing costs and times, but at the same time allowing a cautious and safe approach to the area to be treated. This allows the anatomical control of the structures minimizing the consequent risk of injury to the important vascular-nerve structures.

Therefore, the indication for a radiological study of the anatomical variations of the III branch of the trigeminal nerve is mainly supported by the request to perform any intervention to avoid complications in case of double or triple nerve canal or even motor damage at the level of the joint temporo-mandibular. It therefore seems inappropriate to ask the question about the appropriateness of an increase in diagnostic and operating costs, since the adoption of the innovative diagnostic procedures is clearly in favor of reduced invasiveness and better

convalescence and to the advantage of greater safety with consequent rational evaluation. the cost / benefit in the therapeutic choice.

We therefore believe that the synthesis between basic sciences and medical arts is always desirable and bears indications for a correct and conscious therapeutic action.

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The dermatologists dozen: twelve top tips for reducing the pain of local anaesthetics

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Letter to the Editor

Local anaesthesia (LA) is a commonly used modality to deactivate the body's warning system and stop the transmission of nociceptive stimuli, resulting in pain-free sensation. Dermatological and cosmetic procedures are often facilitated via the usage of a local anaesthetic injection and a major complaint of patients is the "Pinch and Burn" feeling. Minimizing this effect increases patients' satisfaction and makes the experience more pleasant. In this letter, we outline a series of steps that every injector could consider to deliver an optimal local anaesthetic injection with minimal pain.

1. Sodium bicarbonate to buffer anaesthetic

Worldwide, 1% lidocaine with 1:100,000 epinephrine is the most common local anaesthetic in dermatology practice, which is very acidic pH of around 4.2. Extensive evidence supported buffering the solution to reduce the associated burning and pain sensation (1, 2). To increase the pH to nearly 7.4, add 8.4% $NaHCO_3$ with a ratio of 1:10. This makes more unionised molecules of lidocaine readily available to diffuse through the cell membrane, establishing faster onset of anaesthesia. It is recommended to buffer the solution before the injection, as the solution could be unstable after 24 hours (3).

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2. Adrenaline-free anaesthetic

Adrenaline is a vasoconstrictor and is added to slow the rate of absorption and therefore enhancing the duration of LA. Despite its benefits, plain lidocaine can be considered as it is associated with less stinging upon injection, particularly for patients who are averse to pain.

3. Warm your anaesthetic

It has been shown that heating the anaesthetic solution to 37°C or even up to 40°C to 54.4°C (104°F– 130°F) can decrease the pain (4). This is because the increased temperature provides the anaesthetic molecules with higher energy, allowing for a faster plasma membrane crossing and a faster onset of action.

4. EMLA cream prior to injection

Several studies showed the efficacy of applying Eutectic Mixture of Local Anaesthetics (EMLA) cream 60 to 120 minutes prior to injection to attenuate the pain significantly (5). This is because the surface skin is anaesthetized which reduces the sensation of needle stinging.

5. Use smaller/finer needle

A fine needle decreases the chances of hitting the endings of cutaneous nerves. Several studies recommend between 27 and 30 gauge for a needle. In addition, using a small needle promotes a slow puncture and infiltration, which is important to reduce pain.

6. Talkaesthesia

Patients often are anxious especially, before the start of the procedure. Such anxiety can have an impact on the perception of pain. Involving those patients in conversations that provoke their thinking and opinion can distract them (talkaesthesia) (6). Several randomized controlled trails reported that patients engaged in such conversation had a decrease in the self-reported perception of pain during their operations.

7. Gate control theory

Pain can be reduced to some degree by vibrating, rubbing and messaging proximal to the site of injection applying the so called ‘Gate control theory’. This theory suggests with the activation of A-beta non-nociceptive fibers, the pain signals can be overridden and gated at the substantia gelatinosa of the dorsal horn. This happens because A-beta non-nociceptive fibers increase the firing of its interneurons which has an inhibitory impact on the transmission of pain signal via unmyelinated C-fibers.

8. Nerve blocks

Injection around specific nerves can anaesthetise a large surface area of skin without the need for multiple injection points. This is not only beneficial in terms of reducing the pain, but it often requires less amount of LA, decreasing its toxicity risk and offers longer period of anaesthesia. Examples include, anaesthetising the upper lip and the finger by the infra-orbtial nerve block and metacarpal nerve block, respectively.

9. Subdermal (not intradermal) injection

Intradermal injections could induce anaesthesia faster compared to subdermal injections, but this comes at the cost of patient's comfort. This is because the subcutaneous tissue has a lower density and a higher malleability compared to the dermal tissue. More importantly, the nerve endings are less concentrated. This means when injecting, less pain fibers will be activated compared to dermal tissue which is rich in nociceptors.

10. Slow injection

Injection at a slow rate helps the nerve endings to accommodate to the change of stretching and distention of the subcutaneous tissue caused by the anaesthetic infiltration. Furthermore, it provides enough time for those unionised molecules to diffuse through the plasma membrane and blocking voltage-gated channels of sodium.

11. New needles

Use different needle for every insertion, including when drawing up from a vial (7). Every insertion can dull the tip of the needle and affect its sharpness. The sharper the needle is, the less force is needed to puncture the skin.

12. Reinsert within the blanched border

Often, multiple reinsertion points are needed to anaesthetise a large surface area, for instance a forearm tendon transfer. In such cases, the injector should inject within 1cm of the white blanched area of skin and proceed slow. This blanched skin is an indicator of lidocaine's presence, which ensures the numbness of the skin.

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Concerns beyond dermatology and cosmetics in our Discipline. Awareness and knowledge of sexually transmitted diseases (STDs) among population in Georgia. An epidemiological survey

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Abstract

The Centers for Disease Control and Prevention (CDC) estimates that nearly 20 million new STIs occur every year in this country, half of those among young people aged 15 to 24 (syphilis, gonorrhea, chlamydia and trichomoniasis). A real increase in incidence is due to the increased tendency to have unprotected sex without using a condom (1, 2). Another reason of the increased incidence is certainly related to the disinterest of most of population against these infections; this absence of interest is linked to lack of information dedicated to this subject, especially by young people and as a result to poor knowledge of the problem represented by the STIs (3). It is also important to point out that in most developing countries, where the widespread use of antibiotics in the past decades has led to a drastic reduction in the spread of STIs, there is now a marked increase in viral STIs such as genital herpes and warts, and the re-emergence of diseases such as syphilis and lymphogranuloma venereum almost completely disappeared, (4). In fact, from the mid-1990s, the increase in diagnoses of sexually transmitted infections, including syphilis, gonorrhea and chlamydia were reported in several European countries, especially among

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adolescent between 16-19 years (2). In addition, the sexually transmitted infections are a major health problem that affects mostly young people, not only in developing but also in developed countries. Noteworthy, the statistical reference of the Ministry of Internally Displaced Persons from the Occupied Territories, Labor, Health and Social Affairs of Georgia, National Center for Disease Control and Public Health, 2018.

Introduction

The aim of the study was to assess the risk of sexually transmitted diseases in the society of reproductive age and to protect oneself from them.

Materials and methods

The survey instrument was an online self-administered anonymous questionnaire conducted using Google survey software, which automatically populates and saves digital responses to a secure database protecting participant confidentiality throughout the surveying process. The survey was conducted in 2019. The opportunity to participate in the questionnaire was one-time. The questionnaire for this study was developed based on a review of literature. The questionnaire contained 11 questionnaires and 2-6 approximate answers. 3074 persons took part in the survey. Of these, 73.2% (N=2250) - Female, 26.8% (N=824) - Male. The age was distributed as follows: 39.9% - 21-25 years. (N=1224); 37.9% - 25 <yr. (N=1164); 18.3% - 18-20 years. (N=561); 4.0% - 15-17 years. (N=125). (Table I, II).

	2016		**2017**		**2018**	
	Number of cases	Incidence per 100000 inhabitants	Number of cases	Incidence per 100000 inhabitants	Number of cases	Incidence per 100000 inhabitants
Syphilis	1349	36.3	1244	33.4	1243	33.4
Gonococcal infection	923	24.8	798	21.4	765	20.5
Chlamydial infection	2507	67.4	2446	65.6	2084	55.9
Trichomoniasis	6880	185.0	5933	159.1	5137	137.8

Table I. *New cases of sexually transmitted infections, Georgia.*

		Age groups											
		all		0 - 14		15 - 19		20 - 29		30 - 39		40 and over	
		Number Of cases	incidence	Number Of cases	incidence	Number Of cases	incidence	Number Of cases	incidence	Number Of cases	incidence	Number Of cases	incidence
Syphilis, all forms	M	773	43.2	0	0	18	16.4	239	95.0	251	95.9	265	34.1
	W	470	470	2	1.5	1.5	5.1	109	45.6	174	66.2	180	18.4
Gonococcal infection	M	580	32.4	0	0	37	33.7	361	143.5	137	52.4	45	5.8
	W	185	9.6	0	0	1	1.0	88	36.8	66	25.1	30	3.1
Chlamydial infection	M	614	614	0	0	614	26.4	279	110.9	226	86.4	80	10.3
	W	1470	614	0	0	57	58.5	765	320.2	501	190.6	147	15.0
Trichomoniasis	M	1207	67.4	1	0.7	28	25.5	588	233.7	392	149.8	198	25.5
	W	3930	20.3	46	34.1	221	1906	1906	797.8	1162	442.0	595	60.8

Table II. *Sexually transmitted infections, new cases distribution by age and sex, Georgia, 2018.*

Results

The results of the study revealed a lack of knowledge about sexually transmitted diseases. Underestimation of the primary clinical signs of sexually transmitted diseases. Lack of awareness of the necessity and use of defense methods, as well as consultation with a non-specialist doctor, not only leads to the spread of the disease but also endangers the health that can lead to infertility. All this is reflected in the demographic aspect as well. We have submitted the existing issue to the Ministry of Education, Science, Culture and Sports of Georgia for consideration. "Inclusive Learning Support" program "Second Chance of Education through Social Inclusion" sub-program, which allowed us to conduct a lecture-seminar with teachers, because the existing problem and questions are addressed to them in the first place. Numerous questions were asked during the lecture-seminar, which mainly included a question asked by a student that had no answer or the teacher tried to answer it through a social network. As you know, many skin diseases, which can also be infectious in nature, occur in preschool and school-age children. In the upper classes, we face another problem, which is called sexually transmitted diseases and their spread.

Discussion

As you know, many skin diseases, which can also be infectious in nature, occur in preschool and school-age children. In the upper classes, we face another problem, which is called sexually transmitted diseases and their spread. From all of the above, there is a need to develop appropriate educational programs for the sexual education of school-age and adolescent youth, which will help prevent the spread of sexually transmitted infections and establish a healthy lifestyle.

Conclusions

In general, the studies reported low levels of knowledge and awareness of sexually transmitted diseases. Although, as shown by some of the findings on condom use, knowledge does not always translate into behavior change, adolescents' sex education is important for STD prevention, and the school setting plays an important role.

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