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Safety analysis of selected cosmetic treatments

***Abstract**. The paper presents the results of electromagnetic field measurements to which both the client and the staff of the equipment in beauty salons are exposed. The examined object was a device for facial beauty treatments using ultrasound. The measurements were made with a Maschek type ESM 100 meter. The maximum value of the electric component E=158 V/m was measured in the environment of the service staff (beautician) and magnetic induction B=628 nT. A statistical analysis was performed in Statistica 13.3 in order to observe the exact differences between the measurement with the device switched off (background) and the device in operation.*

Streszczenie** W pracy przedstawiono wyniki pomiarów pola elektromagnetycznego na które narażony jest zarówno klient jak i obsługa aparatury w salonach kosmetycznych. Badanym przedmiotem było urządzenie do zabiegów upiększających twarz z wykorzystaniem ultradźwięków. Pomiary wykonano miernikiem firmy Maschek typ ESM 100. Maksymalną wartość składowej elektrycznej E=158 V/m zmierzono w otoczeniu personelu obsługi (kosmetyczki) natomiast wartość indukcji magnetycznej B=628 nT. Wykonano analizę statystyczna w programie Statistica 13.3 w celu zaobserwowania dokładnych różnić miedzy pomiarem przy urządzeniu wyłączonym (tło), a pracującym. **(Analiza bezpieczeństwa wybranych zabiegów kosmetycznych).

Keywords: electromagnetic field, exposure, ESM 100 meter, beautician.
Słowa kluczowe: pole elektromagnetyczne, narażenie, miernik ESM 100, kosmetyczka.

Introduction

The philosophy of modern times is: "Live happily (consume) and look good!". TV commercials constantly promote a young, attractive appearance. Unfortunately, the passage of time affects our appearance. We care most about our appearance during job interviews, weddings and other family celebrations. We are reluctant to think about old age, so we continue to read in the Internet about cosmetic rejuvenation treatments [1],[2].

Comparing contemporary possibilities with what was possible 10 years ago or 20 years ago, we see a visible progress in both treatments and the development of the equipment used for this purpose. A cosmetic treatment is performed for a specific purpose, which is to relax us, improve our face (skin) appearance and make us look better and younger [3], [9].

Individual beauty parlours are outdoing each other in the form of encouragement and a range of possibilities.

What does a potential client consider when deciding on a cosmetic treatment? They are certainly attracted by the salon's reputation, the "slipper mail" recommendation, in a way determined by their age and financial possibilities. The authors of the article asked themselves whether visits to the beautician in terms of the client's (and staff's) health are really safe? The question was further posed - are the devices which are in the salon's equipment really safe for customers due to the emission of electromagnetic fields [13-16].

Method and materials

The research on the spatial distribution of electromagnetic field in the surroundings of the device for performing cosmetic procedures with the use of ultrasound was performed using the ESM-100 meter by Maschek together with software installed on a PC. The ESM 100 meter is a universal device for measuring the electric and magnetic components of electromagnetic fields. The measuring range of the meter is: field E: 0.1 V/m – 100 kV/m and field B: 1 nT – 20 mT. The measurement accuracy is: +/- 5%, in the range: 50 nT – 20 mT, 5 V/m – 100 kV/m [4-8,17]. The tested device is powered from a 50 Hz mains power supply (Fig. 1).

In order to observe the difference in the measurements of cosmetic devices, the first measurement of the so-called background was made when the devices were not working.

The results of the measurement without the device's background are shown in Figure 4.

Fig.1. Device for performing cosmetic procedures with the use of ultrasounds

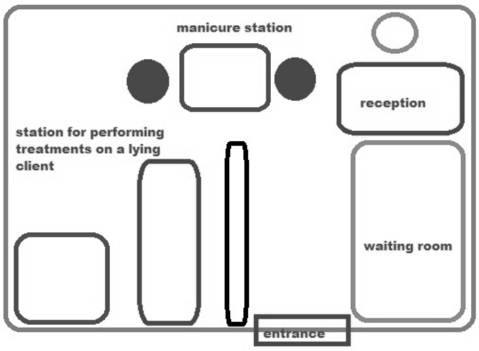

Fig.2. Parlous plan in which experimental research was carried out

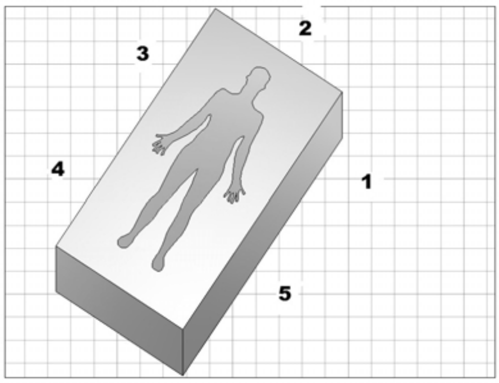

Fig. 3 Example of a client lying on a bed in a beauty salon with 5 measurement points marked

a)

b)

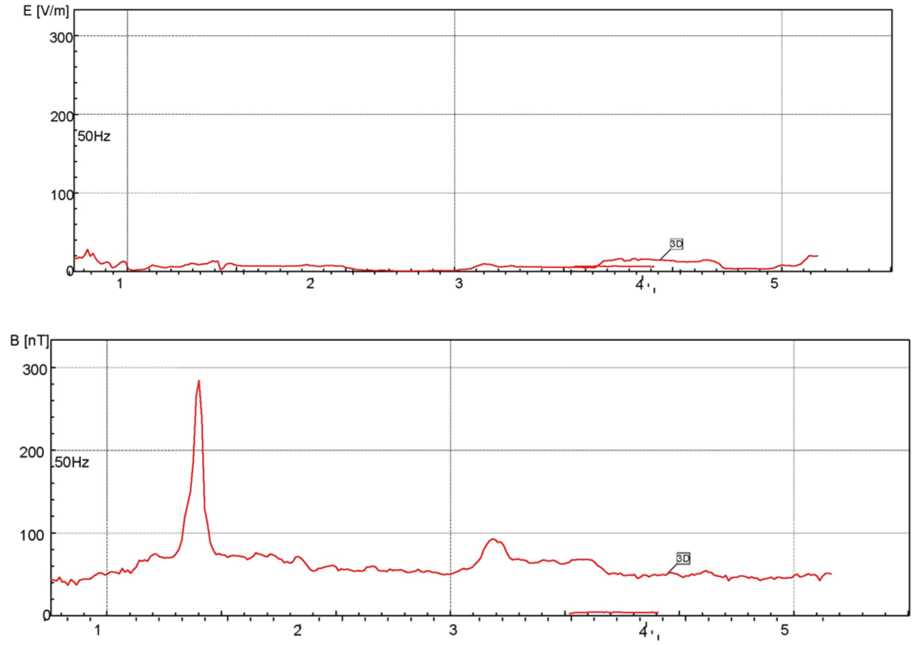

Fig. 4. Measurement of the background electromagnetic field of the surgery, a) electric component E,(V/m), b) magnetic induction B, (nT)

a)

b)

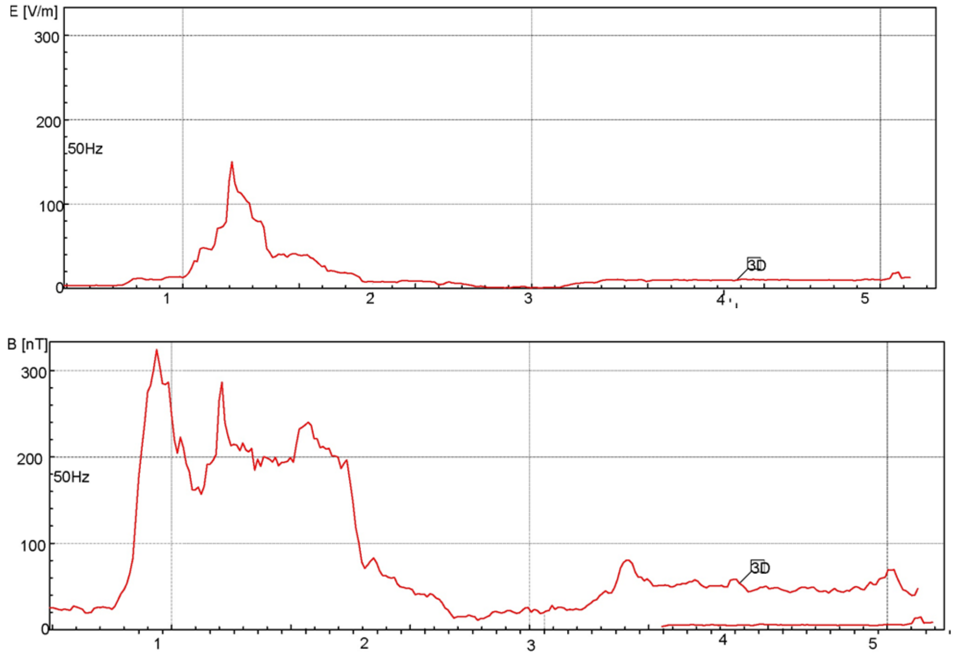

Fig. 5: Measurement of the electromagnetic field during operation of the device, a) electric component E,(V/m), b) magnetic induction B, (nT)

Then, under the same conditions, the electric and magnetic components of the electromagnetic field were measured at five measurement points with the full cycle of operation of the device for cosmetic treatment. Figure 5 shows the results of electromagnetic field measurement with the ESM 100.

Then, at the same measurement points, the electromagnetic field was measured with the Maschek ESM 100. Figure 5 shows the results of electromagnetic field measurement for five measurement points.

The maximum value of the electrical component is E=158 V/m between measuring point 1 and 2. The maximum value of magnetic induction B=628 nT. It can be seen that there is a difference between the background measurement and full scale operation of the tested device.

In order to show the exact differences between the background measurement and the switched on device the data was implemented in Statistica 13.3 software. The values of the analyzed variables were characterized by the mean, median and standard deviation. A 5% inference error and associated significance level $p<0.05$ indicating the existence of statistically significant differences were assumed. The data graph with the range of variability showing the median together with the lower and upper quartile for the selected device in relation to the background measurement for the electric component is shown in Figure 6.

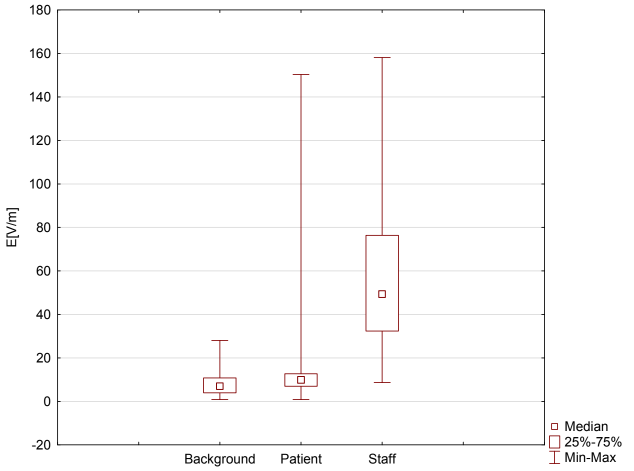

Fig. 6. Box plot for measurement of electric component of electromagnetic field in a beauty salon

The characteristics of magnetic induction are shown in Figure 7.

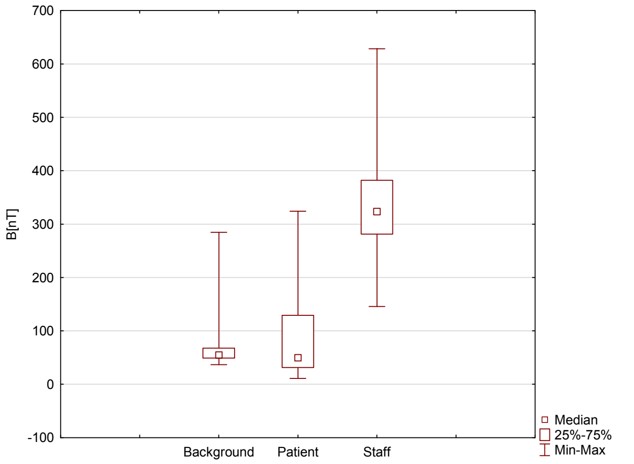

Fig. 7. Box plot for measurement of the magnetic induction in a beauty salon

The electromagnetic field characteristics are presented in Table 1 giving the mean, minimum, maximum *z* and standard deviation.

Analysing the background measurements in relation to the measurements obtained during the procedure one can notice that the values for magnetic induction are twice as high. The electric field produced by the device is several times higher. To verify this hypothesis, the differences between the averages for individual cases were examined. Fig. 8 shows a diagram of a box plot with marked averages and standard deviation for the electric component.

Table 1. Electromagnetic field characteristics

	Mean	Min	MAX	SD (standard devation)
		E [V/m]		
Background	21.09	6.00	95.90	14.68
Patient	16.67	0.85	150.27	22.97
Staff	56.29	8.61	158.10	33.23
		B [nT]		
Background	85.60	11.00	324.30	78.28
Patient	398.17	298.14	569.25	48.75
Staff	334.10	145.43	628.07	81.15

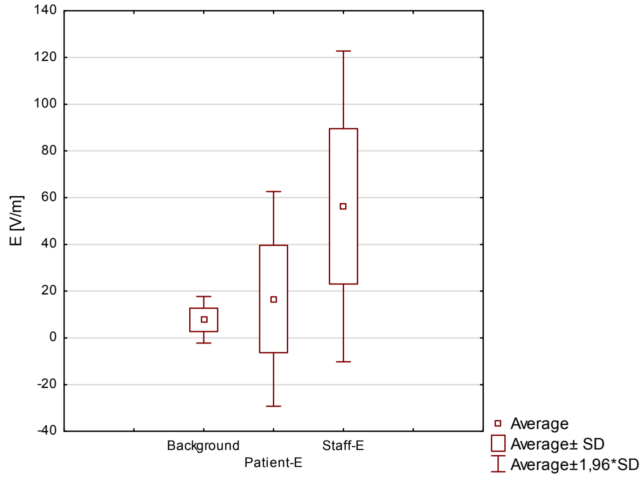

Fig. 8 Box plot for the measurement of the electrical component of the device – mean/standard deviation

Figure 9 shows a diagram of a box plot with marked averages and standard deviation for the magnetic component.

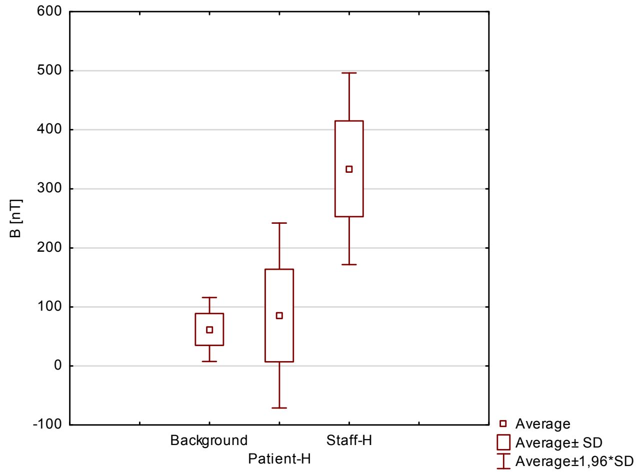

Fig. 9: Box plot for the measurement of the magnetic induction of the device – mean / standard deviation

From Fig. 8 and 9 it can be seen that there are differences of the electromagnetic field intensity between the background and the tested device for both the customer and the beautician.

Conclusions

The highest values for the magnetic induction have been achieved at measurement point 1. The personnel operating the equipment (beautician) are exposed to these values. The maximum value for the magnetic induction- B was 628 nT. The maximum value of electric component of the electromagnetic field E is 158 V/m. The personnel operating the devices (beautician) as well as the head of the client of the beauty salon are exposed to these values. However, the normative values set out in Directive 2013/35/EU of the Parliament and of the Council have not been exceeded both for IPN (E) interventional exposure levels, in the frequency range (50 ≤ f ≤ 1.64 kHz) and for IPN (B) in the range (25 ≤ f ≤ 300 Hz) [10-12]. Comparing the obtained values of electromagnetic field to national regulations, i.e. the Ordinance of the Minister of Family, Labour and Social Policy of 30 June 2016, item 952, the values of both the electric and magnetic components (IPNp-E, IPNp-H – safe zone EM field) were not exceeded [18].

Measurements of electromagnetic field strength continuously monitor the values of electromagnetic field intensities to which people are exposed.

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REFERENCES

[1] Bieńkowski P., Optimization of radiocommunication installations for minimizing exposure the environment to the EMF, 2020, *Przegląd Elektrotechniczny*, 1(1), 228-231
[2] Gas P., Modelling the temperature-dependent RF ablation produced by the multi-tine electrode, *Przegląd Elektrotechniczny*, 2020, vol. 96, no. 1, 48-51
[3] Gas P., Miaskowski A., Implant Safety Tool Application to Assist the Assessment of Radio-Frequency Radiation Exposure, *Journal of Ecological Engineering*, 2019, vol. 20, no. 10, 24-33
[4] Jun S., Kochan O., Chunzhi W., Kochan R., Theoretical and experimental research of error of method of thermocouple with controlled profile of temperature field, *Measurement Science Review*, 2015, 15(6), 304-312
[5] Jun S., Kochan O., Common mode noise rejection in measuring channels, *Instruments and Experimental Techniques*, 2015, 58(1), 86-89
[6] Liu S., Chai K., Zhang Ch., Jin L., Yang Q., Electromagnetic Acoustic Detection of Steel Plate Defects Based on High-Energy Pulse Excitation, *Applied Sciences*, 2020, 10 (16), 5534
[7] Mazurek P., Michałowska J., Kozieł J., Gad R., Wdowiak A., The intensity of electromagnetic fields in the range of GSM 900, GSM 1800 DECT, UMTS, WLAN in built-up areas, *Applications of Electromagnetics in Modern Techniques and Medicine* (PTZE), 2018, DOI: 10.1109/PTZE.2018.8503156
[8] Michałowska J., Tofil A., Jóźwik J., Pytka J., Legutko S., Siemiątkowski Z., Łukaszewicz A., Monitoring the risk of the electric component imposed on a pilot during light aircraft operations in a high-frequency electromagnetic field, *Sensors* (Switzerland), 2019
[9] Pytka J.,Budzyński P., Łyszczyk T., Józwik J., Michałowska J., Tofil A., Błażejczak D.,Laskowski J., Determining wheel forces and moments on aircraft landing gear with a dynamometer sensor, *Sensors (Switzerland)*, 2020
[10] Michałowska J., Tofil A., Jóźwik J., Pytka J., Budzyński P., Korzeniewska E., Measurement of high-frequency electromagnetic fields in CNC machine tools area, *Proceedings of the 2018 IEEE 4th International Symposium on Wireless Systems within the International Conferences on Intelligent Data Acquisition and Advanced Computing Systems*, IDAACS- SWS, 2018
[11] Michałowska J., Wac-Włodarczyk A., Kozieł J., Monitoring of the Specific Absorption Rate in Terms of Electromagnetic Hazards, *Journal of Ecological Engineering*, 2020, 21(1), 224-230
[12] Mika D., Michałowska J., Measurements of the level of harmful factors in the workplace of numerically operated milling machine, *Przegląd Elektrotechniczny*, 2016
[13] Pater Z., Tomczak J., Bulzak T., Bartnicki J., Tofil A. Prediction of crack formation for cross wedge rolling of harrow tooth preform, *Materials,* 12(14), 2019
[14] Pater Z., Tofil A., Tomczak J., Steel balls forming by cross rolling with upsetting, Metalurgija (2013) 52(1) 103-106
[15] Pieniak D., Walczak A., Walczak M., Przystupa K., Niewczas A., Hardness and wear resistance of dental biomedical nanomaterials in a humid environment with non-stationary temperatures, *Materials*, 2020
[16] Przystupa K., Pohrebennyk V., Mitryasova O., Kochan O., Assessment of the electromagnetic radiation level of vehicles, computers, household appliances, personal care products, mobile phones and smartphones, *Przegląd Elekrotechniczny*, 2020
[17] Przystupa K., Pohrebennyk V., Mitryasova O., Kochan O, The influence of electromagnetic field on human health, 2019 *Applications of Electromagnetics in Modern Engineering and Medicine*, PTZE 2019
[18] Rozporządzenia Ministra rodziny, pracy i polityki społecznej z dnia 30 czerwca 2016 poz. 952 w sprawie najwyższych dopuszczalnych stężeń i natężeń czynników szkodliwych dla zdrowia w środowisku pracy