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Complications of implantation of aesthetic foreign bodies depending on their chemical composition

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Abstract

The study was aimed to assess the frequency of implantation of aesthetic foreign bodies depending on their chemical composition

There was demonstrated that 49.4% of patients with complications after auricular piercing have jewelry made of gold and silver, less commonly used titanium. The most common complications for patients wearing silver ear piercing ornaments are atheromas (12,9%), gold - infection (11,8%), for composite alloys – infection and perichondritis (8,6% each) and for titanium – ear laceration and other mechanical defects (7,6%)The highest risk of inflammatory complications was determined for the groups using gold earrings (375 millesimal finenesses) and stainless earrings.

Key words: piercing; complications; foreign bodies; chemical composition

Body piercing is a well-known and popular method of body decoration. Auricular piercings have been known since ancient times. This tradition has independently originated in such diverse places as North America, the Amazon, Asia, Africa, Polynesia and New Zealand [1]. A recently mummified body (Iceman Ötzi) with pierced ears and enlarged ear lobes (7-11 mm in diameter) was found frozen in an Austrian glacier, tests have shown that this mummy is 5300 years old [2]. Today, piercing is a micro-operation related to the perforation of the

skin, mucous membrane, muscles, cartilage, with the subsequent use of various jewelry in surgical steel, titanium, precious and polymeric materials.

The popularity of piercing in the world increased significantly in the world in the 1970s [1, 3], to date, more than a half of people in the world have piercings [3, 4] Unfortunately, body piercing procedures are not free from health risks. Such procedures result in various complications [9]. Their frequency is estimated by various experts from 15 to 45,6% [4-6]. Performing piercings in the ear may be accompanied by local infection and / or bleeding, inflammation of an infectious nature, hematoma, chondritis and perichondritis, granuloma or granulomatous reaction, formation of keloid scars and traumatic rupture of the ear lobe. Serious complications are observed in only 3%, but in people with atopic dermatitis or immunodeficiency the risk of infectious complications is significantly increased [4, 5].

The study of the role of heavy metals in the human body is of great interest because they, accumulating in plant, food and household substances, can enhance their allergenic properties. Therefore, the role of heavy metals and allergies to them is studied in many research centers in Poland, Germany, Sweden, Italy, France, Japan and many other countries. Over the past decades, the study of nickel allergy has become relevant. Nickel has long been known as a major skin allergen [7]. The use of piercing products made of inappropriate material in contact with the skin is one of the risk factors that lead to allergies. Any metal in the biological environment is subject to corrosion with the formation of ions, which leads to local and systemic toxic effects and hypersensitivity reactions. In an effort to reduce the occurrence of nickel-induced complication, the European Parliament and the Council of the European Union adopted Directive 94/27 / EU in 1999, specifying the permissible concentration of Ni in products worn in the ears and other parts of the human body. The mass concentration of Ni in the homogeneous part of the product should not exceed 0.02%, for products intended for long-term use, which are in constant contact with the skin [7, 8]

The study was aimed to assess the frequency of implantation of aesthetic foreign bodies depending on their chemical composition

Material and methods

The study was performed at the ENT department of Kharkiv Regional Clinical Hospital during 2015-2018. 93 patients were referred to the ENT department for complications after the piercing procedure. The qualitative composition of the ear piercing ornaments (earrings) was investigated by the contact-diffusion method and the X-ray fluorescence spectral analysis method in the State Scientific Institution "Scientific and

Technological Complex" Institute of Single Crystals "of NAS of Ukraine" of the Department of Analytical Chemistry and Environmental Objects of the Chemical Safety Control Laboratory.

To measure the content of metals and trace elements in the samples of healthy and inflamed part of the ear, we used the method of atomic absorption spectrometry with electrothermal atomization of the substance. Measurements were performed on an iCE 3500 atomic absorption spectrophotometer with the GF95Z electrothermal atomizer GF95Z from Thermo Fisher Scientific Inc.

Statistical analysis of the obtained results was performed by methods of variance and correlation analysis using Statistica 10.0 software (Dell StatSoft Inc., USA).

Results

Of the total mass of carriers of auricular piercing silver articles were worn by 21 (22,6%) persons, gold of different metric sample – 25 (26,9%) persons, stainless medical alloys – 37 (39,8%), titanium – 10 (10,8%) persons (Fig. 1).

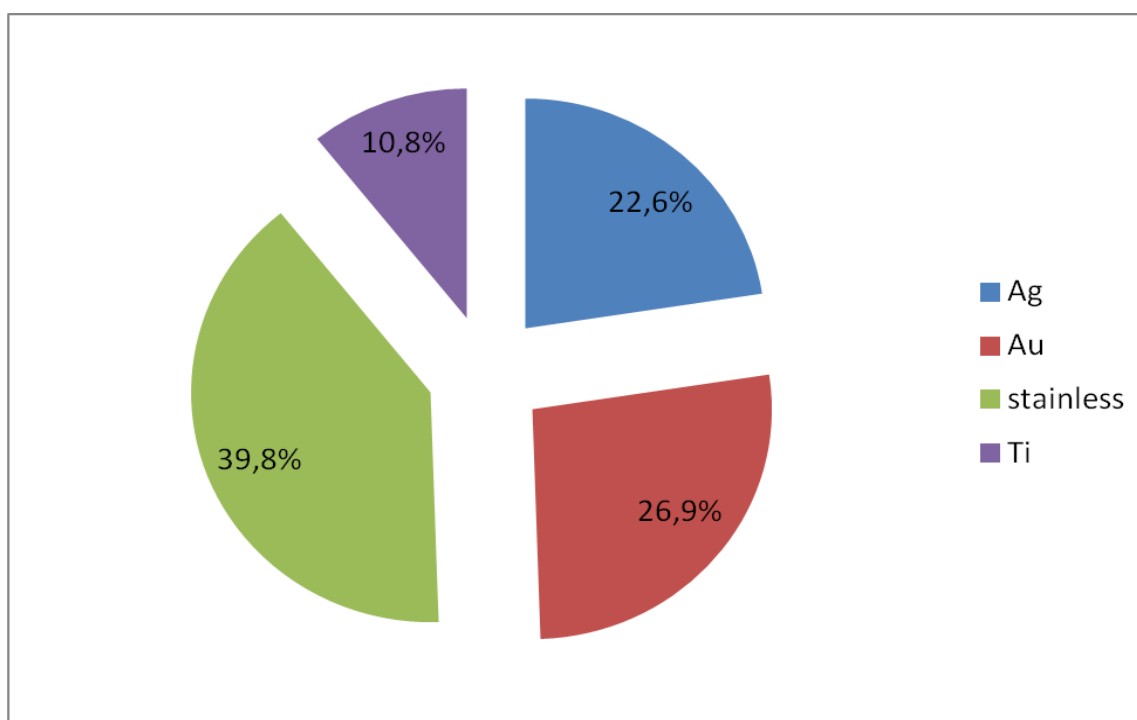


Fig. 1 Chemical composition of jewelry for auricular piercing in patients with complications

A more detailed analysis of the chemical composition of the earrings showed that it varies widely. As shown by the results of the spectral X-ray fluorescence analysis, the elemental composition of the samples of jewelry gold (585 millesimal finenesses) was almost

identical and represented: Au - $59,7\pm 0,08\%$, Cu - $35,8\pm 0,08\%$ - $36,6\pm 0,08\%$, Ag - $3,2\pm 0,02\%$ - $4,1\pm 0,03\%$, Zn - $0,3\pm 0,008\%$ - $0,5\pm 0,01\%$; the composition of the samples of piercing products from medical gold (375 millesimal finenesses) was represented by the same content of elements: Fe - $41,5\pm 0,11\%$, Ni - $32,7\pm 0,1\%$, Cr - $13,5\pm 0,08\%$, Au - $8,2\pm 0,05\%$, which does not meet quality standart. Based on our results 20 out of the 25 respondents used ornaments for the auricular piercing 375 millesimal finenesses.

Silver ornaments had small differences in elemental composition, a half of tested earrings had Ag - $89,2\pm 0,06\%$ - $89,8\pm 0,03\%$, Cu - $7,3\pm 0,03\%$ - $9,8\pm 0,06\%$, Zn - $1,1\pm 0,01\%$ - $2,9\pm 0,02\%$, the other two samples had the following composition: Ag - $93,9\pm 0,03\%$ - $94,9\pm 0,03\%$, Cu - $3,3\pm 0,025\%$ - $3,9\pm 0,03\%$, Zn - $1,7\pm 0,02\%$ - $2,2\pm 0,02\%$.

For titanium piercing samples, no chemically pure titanium was found. Instead, tested ornaments consisted of a multicomponent alloy: Ti - $93,4\pm 0,04\%$, Al - $1,7 \pm 0,03\%$, V - $4,9 \pm 0,04\%$.

Stainless iron-containing alloy products also contained Cr ($10,5\pm 0,04\%$ to $17,5\pm 0,9\%$) in addition to Fe ($64,5\pm 0,1\%$ to $72,6\pm 0,04\%$), Ni ($1,1\pm 0,02\%$ to $12,6\pm 0,04\%$), Mn ($1,04\pm 0,01\%$ to $14,9\pm 0,05\%$), Cu ($0,09\pm 0,003\%$ to $2,4\pm 0,02\%$), Mo (from trace amounts to $1,7\pm 0,007\%$). This group of earrings also does not meet standart, as it exceeds the level of nickel.

When assessing the frequency of complications in patients-carriers of products of different metals, it was found that atheroma, contact dermatitis, perichondritis, ear defects, earlobe tears and ear lacerations, as well as soft tissue infections and keloid scars were detected in patients depending on the chemical composition of the decoration. 1)

Table 1 Frequency of complications in patients-carriers of the ornaments for auricular piercing from different materials (abs., %)

Complications	Ag (n=21)		Au (n=25)		Comp (n=37)		Ti (n=10)	
	Aбс.	%	Aбс.	%	Aбс.	%	Aбс.	%
Atheroma	12	12,9						
Contact dermatitis	5	5,4			2	2,2		
Infection	4	4,3	11	11,8	8	8,6	3	3,2
Perichondritis			7	7,5	8	8,6		
Keloid scar			8	7,5				
Tear of earlobe					6	6,5	2	2,2
Split ear/Ear laceration					13	14,0	5	5,4

Patients with perichondritis complained of pain in the piercing area. Objectively: the surface of the auricle was hilly, reddened, shiny, with a glossy gloss, there was swelling, increase in size, and the skin temperature in the affected area was increased.

Among the complications found in patients wearing gold articles, 32.0% had keloid scars. Patients complained of pain, itching in the area of the scar, skin tightening and paresthesia in the piercing area. Objectively, a tight, round or oblong shape was defined in the piercing area. With small keloids (0.1-0.4 cm), the skin above them is shiny sometimes hilly, with large sizes it has a color from pale pink to purple-cyanotic. Keloid, in its shape, resembled a tumor and had invasive growth beyond the initial lesion, while strongly standing out on its surface (Fig. 2).



Figure 2 - Complications - keloid scar on the ear after wearing gold earring

The most diverse spectrum of complications was observed in carriers of ferrous alloy products. In every second patient manifestations of soft tissue infection and signs of perichondritis (21.6% each) were determined. Objectively: in the area of the ear, palpation, swelling and hyperemia (Fig. 3), except for the cartilage-free lobe. The suppuration and accumulation of pus between the cartilage and the cartilage was marked by fluctuation. The body temperature increased ($37.1^{\circ}\text{C} - 37.8^{\circ}\text{C}$). Even minor cartilage injuries of the ear cartilage provoked these symptoms. We consider perichondritis of the auricle as a consequence of primary infection. An infection could come from the outside directly due to damage to the skin of the ear caused inflammation. Another variant - the secondary infection when the pathogen got into the ear with the bloodstream.

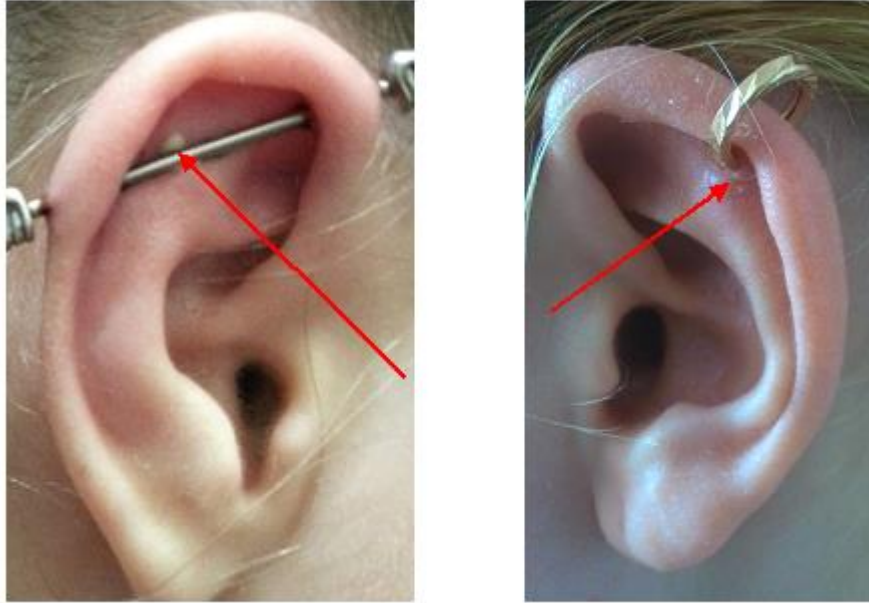


Figure 2 - Perichondritis of the auricle

The smallest number of inflammatory complications occurred with the use of titanium products, however, this type of jewelry was less commonly used, which does not allow to consider the differences as statistically significant ($p > 0.05$)

Further analysis demonstrated the strong correlation between the nature of piercing complications and the composition of metal products. Thus, complications of infectious origin, perichondritis and secondary infection of the auricle, occurred mostly in the group using alloy earrings contained such metals as Pb, Ni, Mo and

The highest risk of inflammatory complications was determined for the groups using gold earrings (375 millesimal finenesses) and stainless, the lowest – for titanium ornaments. However, not only material of earrings determines the risk of complications. The microbial landscape of skin is also should be taken into the consideration.

Conclusions:

1. 49.4% of patients with complications after auricular piercing had a high level of nickel ($1.1 \pm 0.02\%$ to $32.7 \pm 0.1\%$), when using jewelry, which does not meet the quality standart of the European Union Directive

2. The most common complications for patients wearing silver ear piercing ornaments are atheromas (12,9%), gold - infection (11,8%), for composite alloys – infection and perichondritis (8,6% each) and for titanium – ear laceration and other mechanical defects (7,6%)

3. The highest risk of inflammatory complications was determined for the groups using gold earrings (375 millesimal finenesses) and stainless earrings.

References

1. Perper M, Aldahan AS, Tsatalis JP, Nouri K. Modifications of body surface: piercings, tattoos, and scarification. *Int J Dermatol.* 2017 Mar;56(3):351-353
2. Murphy WA Jr, Nedden Dz Dz, Gostner P, Knapp R, Recheis W, Seidler H. The iceman: discovery and imaging. *Radiology.* 2003 Mar;226(3):614-29
3. Yevseyeva Ye.A. Pirsing: somnitel'naya krasota / Ye.A. Yevseyeva // *Byulleten' meditsinskikh internet-konferentsiy.* 2015. T. 5. № 10. S. 1159.
4. Fijałkowska M, Kasielska A, Antoszewski B. Variety of complications after auricle piercing. *Int J Dermatol.* 2014 Aug;53(8):952-5
5. Bellaud G, Canestri A, Gallah S, Merlant M, Cousseau S, Lebrette MG, Slama L, Pialoux G. Bacterial chondritis complications following ear piercing. *Med Mal Infect.* 2017 Feb;47(1):26-31.
6. Lyons M, Stephens J, Wasson J, DeZoysa N, Vlastarakos PV. High ear-piercing: an increasingly popular procedure with serious complications. Is good clinical practice exercised? *Eur Arch Otorhinolaryngol.* 2012 Mar;269(3):1041-5
7. J. P. Thyssen, A. Linneberg, T. Menne, J. D. Johansen The epidemiology of contact allergy in the general population - prevalence and main findings / *Contact Dermatitis.* – 2007. – Vol. 57, N 5. – P. 287-299.
8. Thyssen J. P. Nickel release ´ from inexpensive jewelry and hair clasps purchased in an EU country- are consumers sufficiently protected from nickel exposure?"/ J. P. Thyssen, T. Menne, J. D. Johansen // *Science of the Total Environment.* – 2009. – Vol. 407, N20. – P. 5315-5318.
9. Storonni tila LOR orhaniv: poshyrenist', uskladnennya /A.S. Zhuravlev, M.Y. Yashchenko, O.V. Bondarenko // *Zhurnal vushnykh, nosovykh i horlovykh khvorob.* 2015. - №5. – S.58.