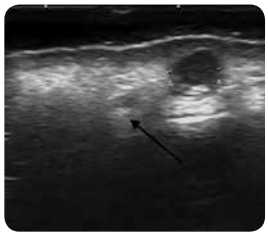

HIGH RESOLUTION ULTRASOUND OF SOFT TISSUES FOR CHARACTERIZATION OF FILLERS AND ITS COMPLICATIONS

Uso de la ecografía de alta resolución de tejidos blandos para la caracterización de material exógeno y sus complicaciones

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Summary

Introduction: High resolution ultrasound has proven to be a useful diagnostic method for the detection of exogenous material, its characterization and evaluation of its complications. This study is a series of cases of 60 patients collected in a period of 3 years. It is a retrospective, descriptive study. ***Objectives:*** To describe the most frequent locations of the exogenous material in the affected areas of the body. To describe the type of exogenous material most used and its ultrasound appearance. To establish the most frequent complications. ***Methods:*** High resolution ultrasound was performed by a radiologist with eight years of training in dermatological ultrasound. The studies were carried out in a Toshiba Xario 200 device with an 18 MHz lineal transductor. For the statistical analysis, measures of central tendency, description of frequencies and crossing of variables were used. ***Results:*** the average age of the patients was 55 years, 90.5% of the patients were women. The most affected area were the nasolabial folds where exogenous material was found in 85.7% of the patients. The substance most commonly found was biopolymers in 39%; liquid silicone and oil had respectively 32.5% and 15.6%. In 67.2% of the cases the patients presented physical deformity manifested as a palpable or visible mass. ***Conclusion:*** The ultrasound allowed us to identify the different types of exogenous substances, their location in the specific anatomical area and the complications related to their use, providing useful information to the attending physician and impacting the management of the patients.

Resumen

Introducción: El ultrasonido de alta resolución ha demostrado ser un método diagnóstico útil para la detección de material exógeno, su caracterización y evaluación de sus complicaciones. Este trabajo es una serie de casos de 60 pacientes, recolectados en un periodo de tres años. Es un estudio retrospectivo, descriptivo. ***Objetivos:*** Describir

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las localizaciones más frecuentes del material exógeno en las zonas del cuerpo afectadas. Describir el tipo de material exógeno más utilizado y su aspecto ecográfico. Establecer las complicaciones más frecuentes. ***Métodos:*** Se realizó ecografía de alta resolución por parte de una radióloga con ocho años de entrenamiento en ecografía dermatológica. Los estudios se realizaron en un equipo Toshiba Xario 200 con transductor lineal de 18 MHz. Para el análisis estadístico se emplearon medidas de tendencia central, descripción de frecuencias y cruce de variables. *Resultados:* La edad promedio de los pacientes fue 55 años y el 90,5 % fueron mujeres. La zona más afectada fueron los surcos nasogenianos, donde se encontró material exógeno en el 85,7 % de los pacientes. La sustancia encontrada más comúnmente fueron los biopolímeros (39 %), la silicona líquida y el aceite tuvieron, respectivamente, el 32,5 % y 15,6 %. En el 67,2 % de los casos se encontró deformidad física en los pacientes, manifestada como masa palpable o visible. ***Conclusión:*** La ecografía permitió identificar los diferentes tipos de sustancias exógenas, su ubicación en la zona anatómica específica y las complicaciones relacionadas con su uso, lo cual suministró información útil al médico tratante e impactó en el manejo de los pacientes.

1. Introduction and theoretical framework

The exogenous material commonly known as fillers is widely used in dermatology and plastic surgery to diminish the natural effects of aging, such as the development of wrinkles and loss of skin tone, or as a lip and cheek augmentation material. The products available can be divided into two categories: biological (degradable) substances, such as hyaluronic acid, and synthetic (non-degradable) substances, such as silicone, polymethylmethacrylate (PMMA), calcium hydroxyapatite, polyacrylamide and biopolymers (1,2). According to their origin, they are considered exogenous or endogenous, such as autologous fat. At present there is a continuous increase in the use of these substances, either by qualified medical personnel or by unauthorized personnel, with the consequent increase in complications, which are greater when using substances that are not approved for medical use and are the object of bad practice. In this context, it is important to have diagnostic tools that allow adequate detection (3).

High-resolution ultrasound has proven to be a useful diagnostic method for the detection of exogenous material, its characterization and the evaluation of its complications (4-6). Because each of the exogenous substances mentioned has a typical and characteristic ultrasound aspect, ultrasound allows for a specific analysis of the affected face or body area, leading to the detection and identification of the cosmetic filler materials used (7-12).

This work is the result of a series of cases of 60 patients, collected in a period of 3 years, describing the most commonly found exogenous substances, their ultrasound appearance and the complications developed.

The specific purposes of the study were: to describe the most frequent locations of exogenous material in the affected areas of the face; to describe the type of exogenous material most used and its ultrasound appearance; and to establish the most frequent complications.

2. Material and methods

It is a retrospective, descriptive study. Ultrasound reports were analyzed from 60 patients who underwent high-resolution soft tissue ultrasound with indication of the known diagnostic study or suspicion of exogenous material seen in our institution. High-resolution ultrasound was performed by a radiologist with eight years of training in dermatological ultrasound. The studies were analyzed in a Toshiba Xario 200 with high-resolution linear transducers of 18 MHZ. The entire face was ultrasound scanned. A table created for the study and a locator chart were used to record the findings. Complementary Doppler analysis was performed in all cases. The evaluated variables were: sex, age in years, specific location of the filling material in the different areas of the face that were defined: lips, between eyebrows, nasogenian grooves, chin, malars, jaw, upper eyelid, infraorbital rim, external rim of the orbit, nasal tip.

The exogenous substances defined were: hyaluronic acid, liquid silicone, silicone in oil, autologous fat, polymethylmethacrylate (PMMA) and biopolymers, which consist of a mixture of silicone in oil and PMMA.

Complications were defined as: dermatopathy, palpable mass or deformity, granulomas, abscess and fistulas, skin necrosis.

For statistical analysis, measures of central tendency, description of frequencies and crossing of variables were used

3. Results and statistical analysis

The average age of the patients was 55 years, 90.5% of the patients were women. In the 60 patients examined, a total of 271 positive images of exogenous material were found in the different areas of the face. The most affected area of the face corresponded to the nasogenian grooves where exogenous material was found in 37.6% of the positive findings; in the malar region 13.7% and in the interciliar region, 12.2% (figure 1). 36.7% of patients had 2 areas of their face affected, seven patients (11.7%) had exogenous material in a single area of the face and the maximum number of areas affected per patient was 6 areas in 4 patients (6.7%).

Biopolymers were the most commonly found substance (39%), followed by liquid silicone (32.5%) and silicone in oil (15.6%). Hyaluronic acid was only found in 10.4% of cases. The least found substances were PMMA, in one patient, which corresponds to 1.3%, and autologous fat. Twenty-five percent of the patients had more than one exogenous substance on their face.

The main complication was the physical deformity manifested as palpable or visible mass in 67.2% of the patients. In figure 2 other complications are observed.

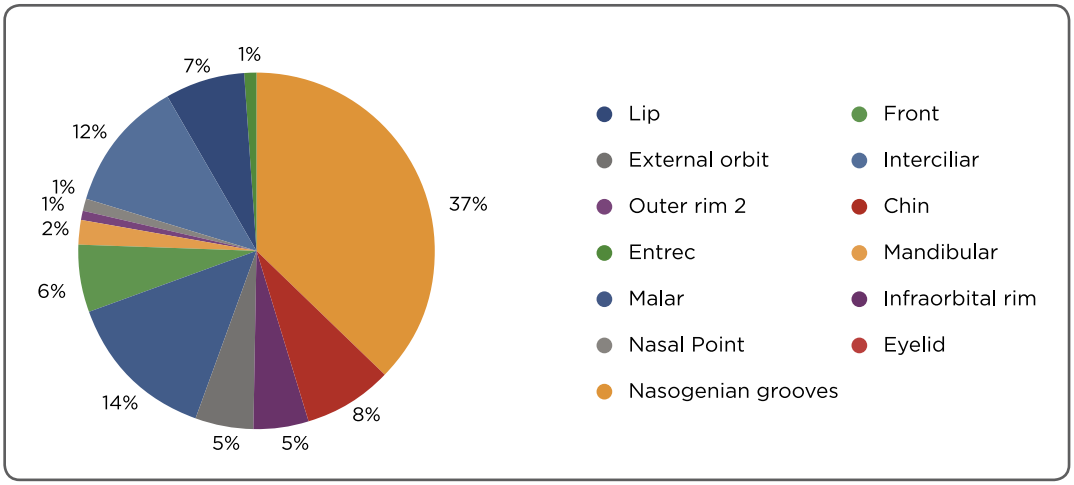

Figure 1. Distribution of areas affected by exogenous material.

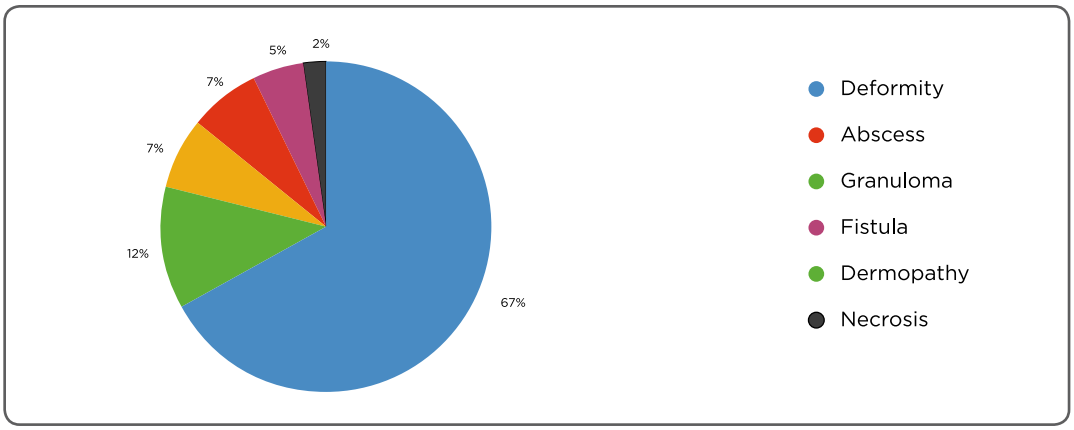

Figure 2. Percentage of complications.

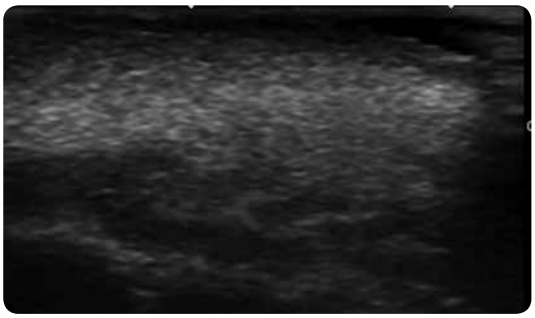

Figure 3. Cheek ultrasound, axial, with 18 MHz linear transducer: characteristic aspect of biopolymers with multiple hyperechogenic points that generate comet small tail artifice, interspersed with hyperechoic focuses with reverberation artifice similar to that observed in the rupture of silicone prostheses.

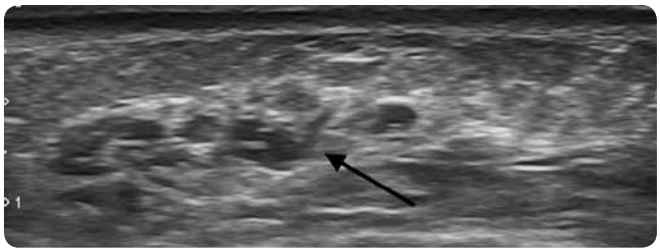

Figure 4. Ultrasound, axial: characteristic aspect of hyaluronic acid with pseudocystic images of well-defined edges (arrow).

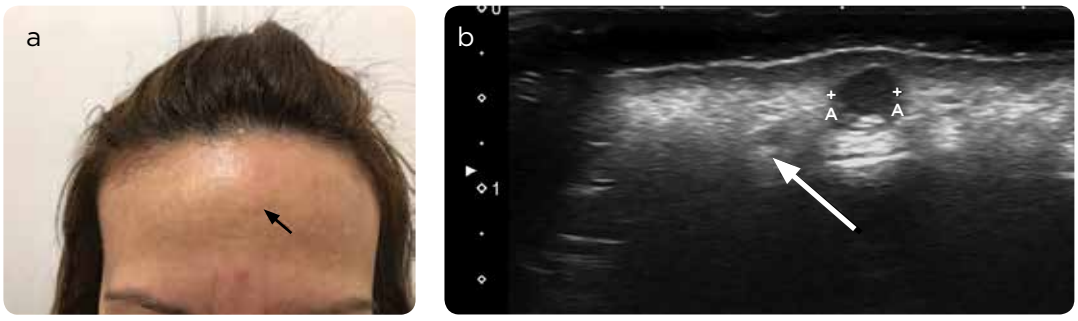

Figure 5. a) Clinical image of frontal region of patient consulting for nodule appearance. b) Ultrasound of frontal region showing two types of exogenous material: silicone in oil, with aspect in snowstorm (white arrow) and pseudocyst corresponding to hyaluronic acid (marks +A).

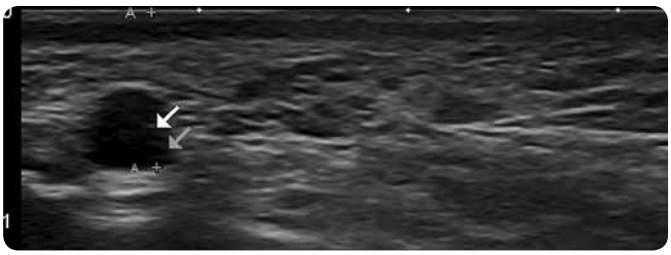

Figure 6. Ultrasound image characteristic of liquid silicone with oval, cystic, hypo-echoic images of well-defined edges (arrows).

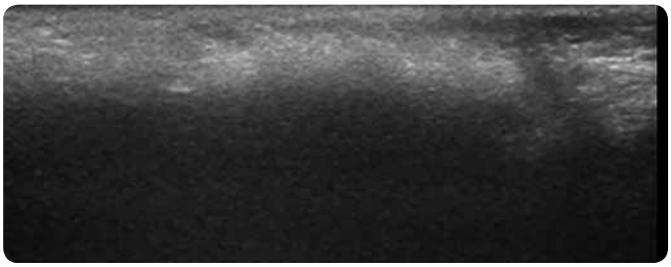

Figure 7. Image with snowstorm artifact characteristic of silicone in oil.

4. Discussion and conclusions

Currently there is an exponential growth of cosmetic procedures in the world. For these, the use of exogenous substances for rejuvenation purposes, known as "fillers" (13), is the one that has increased the most. In the United States, according to data published by the American Society of Plastic Surgery, in 2014 there was an increase in the procedure with filler material of 3% compared to 2013 (14). In Colombia, even though there are no clear statistical data regarding its approved medical use or the development of complications -and even less statistics related to malpractice by unsuitable personnel-, its application is considered to be very common, which generates a frequent and growing public health problem, due to the use of such substances by non-medical trained personnel.

It is well known that the use of filler material substances, even those approved by the FDA, can generate early or late, reversible or irreversible complications, with a broad spectrum that includes cellulite, ecchymosis, hypersensitivity reactions, edema, palpable or visible mass, granulomas, dermatopathy, abscesses, fistulas, necrosis and even blindness (15-21). In 2008, Dr. Felipe Coiffman, a Colombian plastic surgeon, described the indiscriminate handling and development of complications related to these substances as a devastating new disease, which claimed more victims worldwide than AIDS or tuberculosis and called it iatrogenic allogenesis (22). In this scenario, it is important to have diagnostic methods that allow an adequate characterization of the type of exogenous substance, its location, detection and characterization of its complications.

Ultrasound has proven to be a fast, cost-effective and highly effective test for detecting the different types of exogenous material, which also makes it possible to identify the degree of absorption of substances such as hyaluronic acid and precisely guide the injection of hyaluronidase, when required (23). By means of ultrasound it is possible to recognize precisely the type of substance injected, since each one of them presents a characteristic ultrasound aspect that allows to establish with precision which filling material it is (24-26). In our series of cases, the most commonly found substance were biopolymers, which are recognized by the mixture of silicone in oil and PMMA, which in ultrasound appear as multiple hyperechogenic points that generate comet small tail artifice, interspersed with hyperechoic focuses with reverberation artifice similar to that observed in the rupture of silicone prostheses (27) (figure 3). These data are similar to that observed by González and collaborators (28) who found that the substances most related to iatrogenic allogenesis in Colombia were polymethylmethacrylate, liquid silicone and propylene. This contrasts with what has been reported in countries such as the United States, where the injected substance most commonly found is hyaluronic acid, in up to 78% of cases (29, 30). This behavior may be due to the fact that our sample corresponded to a population that had developed some type of complication related to the use of filler material and not to the general population that uses these materials. Hyaluronic acid, which in ultrasound is recognized by anechoic, subcutaneous, pseudocystic images (31-33) (figure 4), was only found in 8 patients, one of them with more than two exogenous substances in his face, who developed acute hematopathic changes after injection of hyaluronic acid (figures 5 a and b). In the others granulomas were observed, which have been described as a rare complication, with incidence from 0.02% to 0.4% (34,35).

In the study population, the preferred facial area for the application of exogenous material corresponds to the nasogenian grooves, as reported in the literature (36).

Cosmetic deformity described as palpable mass was found in 67.2% of patients, which is one of the most common complications (37). Fistulas and abscesses derived from chronic infection could be accurately identified by ultrasound. The most serious complication found in this series of cases was a patient with dermatopathy, abscess and extensive skin necrosis. However, the use of Doppler is obligatory in all cases of ultrasound of exogenous material, since it allows the detection of thrombosis, which has been described as related to the use of these substances (38,39).

The substance that developed the most complications were the biopolymers that, as explained, corresponds to a mixture of PMMA and silicone in oil, commonly used in Colombia, mainly by unsuitable personnel, followed by liquid silicones (figure 6) and in oil (figure 7). Currently, there is worldwide controversy over the use of the latter two substances due to late-observed adverse effects; however, some authors defend the safety of their use (40,41).

In conclusion, ultrasound made it possible to identify the different types of exogenous substances and their location in the specific anatomical zone; in addition, up to 25% of patients were found to contain more than one exogenous substance and 1.7% of patients contained three exogenous substances. Ultrasound is indicated in patients with complications derived from the use of different filling materials, when it is desired to rule out the coexistence of multiple filling substances, establish their degree of absorption and as a preliminary examination to the injection of a filling material in patients with previous suspicion of application of these substances and who deny, do not recognize or do not remember the use of them. In this context, ultrasound reduces

the risk of complications arising from the injection of a second filling material on top of a non-absorbable one and gives useful information to the clinician to avoid possible medical-legal complications.

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