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Case report

Oil injection for cosmetic enhancement of the upper extremities: a case report and review of literature

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Summary. Here the authors report a case of complications occured after injection of a site enhancement oil in the upper extremity for cosmetic muscles' volume enhancement and a literature review on the topic. The medical and sports communities should be aware of the secondary effects of site enhancement oils use, which could bring to severe complications. (www.actabiomedica.it)

Key words: bodybuilding, injections, muscle, oil

Introduction

Intramuscular oil injections generating slowly degrading oil-based deposits represent an increasingly discussed topic in bodybuilding and fitness (1). Site enhancement oils (SEOs) are used purely for cosmetic reasons to increase muscle volume with no beneficial effects on muscle strength. A plethora of SEOs, typically containing various medium-chain oils, xylocaine, and alcohol as preservatives, can be found on the illegal market, as well as homemade formulas (2). The use of this SEOs has been associated with multiple complications, from inflammation and swelling to fat embolism-like syndrome (3). The illegal use of muscle fillers has increased over the past few decades in a few case report and case series (4). Nevertheless, no comprehensive review on adverse effects has been reported so far in medical literature (1, 2, 5-17). Knowledge of these effects could help to decrease the morbidity related to SEO use.

Case Report

A 31-year-old man injected a material similar to silicone (Synthol) for cosmetic reasons into both biceps 4 years prior to presentation, and in the latter 2 years developed painful intermittent edema in both biceps that was uncomfortable and associated with heat and pressure (Figure 1). He denied any drainage in the past, but reported that every time he had infection episodes similar to this, he required antibiotic therapy. His past surgical history included lipoma resection on the right arm and abscess removal on the back in 2004. He smoked half a pack of cigarettes a day, but did not use alcohol. Upper limbs neurovascular and musculoskeletal examination was within normal limits with a normal range of motion. There were multiple areas of induration and cellulite on the bilateral arms along the biceps area.

We performed both magnetic resonance imaging and ultrasonography (Figures 2 and 3), which showed

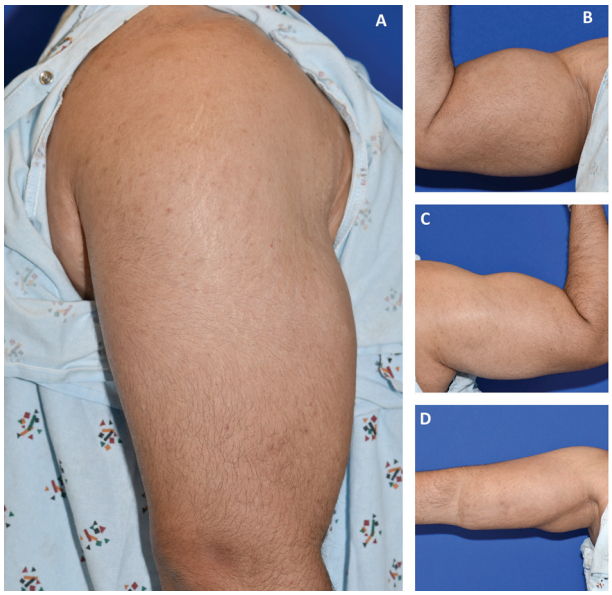

Figure 1. A 31-year-old man who injected synthol oil into both biceps 4 years prior to presentation to our department, with a history of intermittent uncomfortable edema in both biceps, associated with heat and pressure. A, Dorsal surface of the relaxed arm. B, Volar surface of the flexed arm. C, Dorsal surface of the flexed arm. D, Volar surface of the relaxed arm

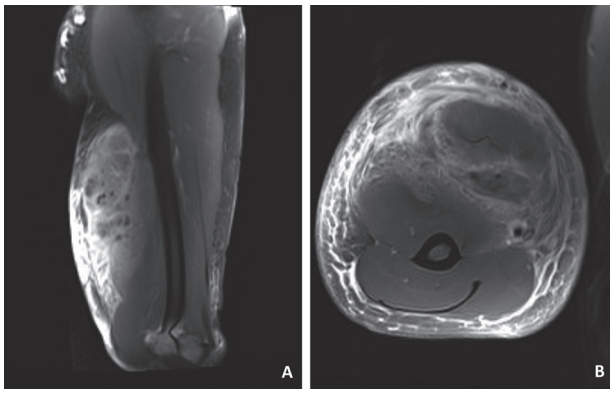

Figure 2. Magnetic resonance imaging findings of the same patient with extensive inflammatory changes throughout the anterior compartment of the musculature and lateral aspect of the deltoid musculature bilaterally, compatible with myositis, fasciitis, and cellulitis. There is diffuse infiltration of the anterior compartment and lateral deltoid musculature with fat or other high-lipid content foreign substance likely related to prior injected foreign material. A, Sagittal section image. B, Coronal section image

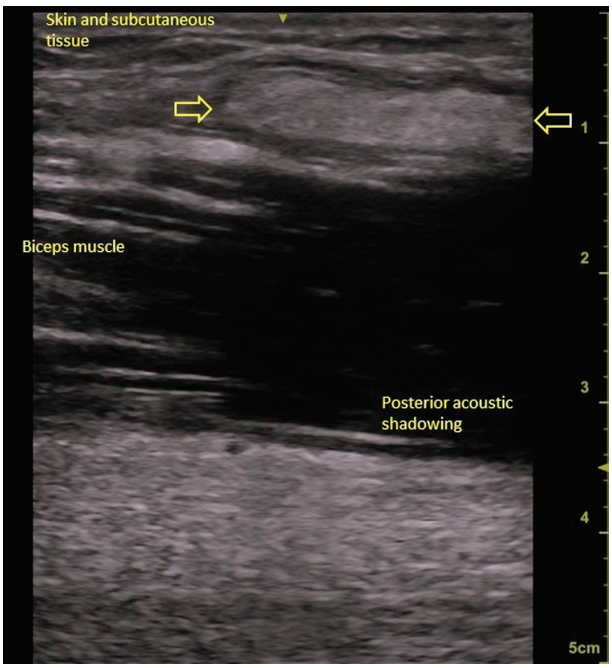

Figure 3. Musculoskeletal ultrasound of the same patient of the anterior right upper extremity imaged in long-axis view with a linear probe at a frequency of 10 MHz. Deep to the skin and subcutaneous adipose tissue is an encapsulated hyperechoic focus representing dense site enhancement oil (open arrows) within the biceps musculature, which causes posterior acoustic shadowing of the deeper biceps musculature due to the inability of the ultrasound wave to penetrate the site enhancement oil. Yellow arrows point to the damaged tissue

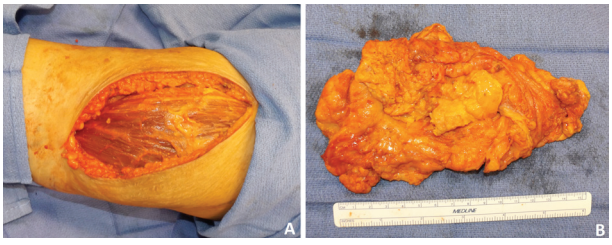

Figure 4. Surgical excision of the damaged tissue in our patient who had injected synthol oil in his biceps. A, Image of the arm immediately after removal of the damaged tissue. B, Surgical specimen.

infiltration of the biceps with injection material. The damaged tissues were surgically removed (Figure 4). Pathology examination showed foreign body giant cell reaction. No further adverse effects were reported prior to patient's return to home country (Figure 5).

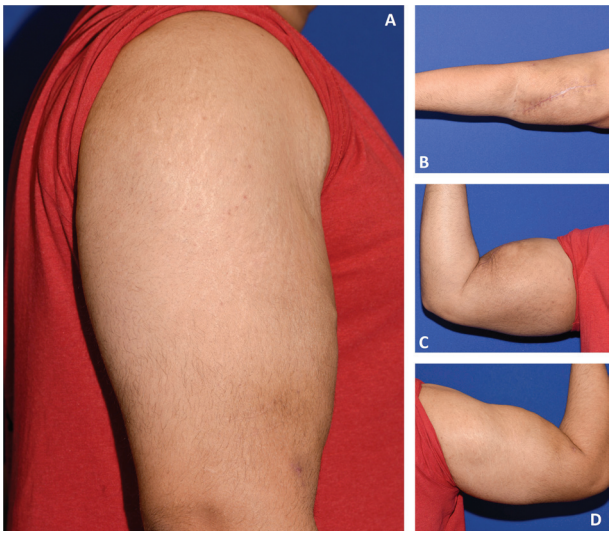

Figure 5. Postoperative photographs of the same patient, 5 weeks after surgery. A, Dorsal surface of the relaxed arm. B, Volar surface of the relaxed arm. C, Volar surface of the flexed arm. C, Dorsal surface of the flexed arm

Discussion

Cosmetic doping is part of the more complex ongoing doping process in sports and among people desiring to look bigger and stronger (4). The injection of different substances for cosmetic reasons to increase muscles' volume has been described since 1899 (3). SEOs were employed as solvents for anabolic steroids by the pharmaceutical industry previously, and started to be used alone by bodybuilders since 1996 (18).

It is thought that SEOs could increase muscular volume by causing muscle fiber hypertrophy and stimulating the appearing of new muscle fibers due to their irritant effect (18). Bodybuilders use these kinds of SEOs as a resource to improve the shape of muscles and to appear more cosmetically attractive as the muscle volume artificially increases. The increasing number of bodybuilders self-injecting oils validate a real concern about this practice (3). Despite immediate positive aesthetic results, several short- and long-term adverse effects to SEOs have been reported.

These adverse effects may occur months to years after injection cosmetic augmentation, and the incidence, though not known, is probably underestimated due to lack of information and literature on this topic.

Muscle-enhancement with damaging substances is a practice more frequent in men than in women, because traditionally men have been more involved in weight training exercises than women; in the past, muscle volume was thought to be an important cosmetic feature for men, more than for women (19). The users of SEOs are typically older than 20 years, and this could be related to difficult access to SEOs and the costs they incur (17).

Different kinds of SEOs such as soy oil, paraffin oil, safflower oil, sesame oil, silicon, coconut oil, and purified long- and medium-chain emulsion, are injected in a pure form or mixed with anabolic steroids (Table 1) (5, 9). The most frequently injected SEO is paraffin oil. This type of SEO had been used earlier, between the years 1950 and 1960, with immediate good aesthetic results but resulted in complications of skin inflammation, edema, abscesses, and lymphangitis. Paraffin oil usually becomes a foreign body and can cause an acute or chronic reaction depending on the dose injected (6). These complications are related to the migration of destructive paraffin oil in the tissues (13).

Synthol oil is a material similar to silicone, considered a doping substance, but unlike others, it does not bring any real benefit to the body or increase athletic performance. It is made of 85% oil, 7.5% lidocaine, and 7.5% alcohol. Its function is to inflate the muscles by being injected directly into the site of desired enhancement (20). The human body is unable to assimilate synthol oil and, therefore, it remains in the muscles for a long time, eventually causing swelling. The muscle enhancement requires several injections until a satisfactory level of muscle size and thickening is reached. Synthol oil does not contain steroids.

Sesame oil is frequently used as a solvent (eg, in intramuscular gold injections for rheumatoid arthritis), and as an alternative to intramuscular injections of steroids (1, 7). Less frequently injected oils and silicone could cause different tissue reactions, such as pseudotumors, that could be confused with other lesions (5). SEOs might cause allergic reactions, such as myalgia and vasculitis, or painful subcutaneous nodules, consistent with paraffinoma or oleoma, and chronic foreign-body reactions to oily substances (3, 7, 14) Histopathology of oleoma, caused by an oily substance, consists in a chronic foreign body reaction

Table 1. Studies describing the use of site enhancement oils

Authors	Year	Location	Age of injection	Sex, Age	Latent Phase	Clinical Appearance/ Symptoms	Injected Substance/ Amount	Treatment	Outcome
Munch and Hvolris (16)	2001	Denmark	26	M, 26	3 weeks	Swelling and tenderness overlying an injection site	Walnut oil 3×10 mL	Penicillin	Lost to follow-up
Di Benedetto, et al (6)	2002	Italy	32	M, mean age=45 years, 7 patients	13 years (mean duration of latent phase)	Extended lipogranulomas, fistulas, hardness of the skin, inflammation, discontinuation of the skin, secretion of oily materials, limitation of flexion and extension	Paraffin oil Amount NR	Wound débridement was performed emergently, with a ligature of the bleeding vessels. A wider débridement of the lesion was performed 10 weeks later because of recurrent fistulas, with the opening of the elbow joint capsule on its posterior aspect. A wide thoracoabdominal flap from the right side was harvested	After 10 weeks, 1 patient had deep fistulas and required a second wider débridement. NR in 6 patients.
Georgieva, et al (7)	2003	Germany	42	M, 44	2 years	Multiple painful subcutaneous nodules on the upper arms	Sesame oil 120 mL	NR	NR
Koopman, et al (14)	2005	Netherlands	21	M, 21	1 week	A severe case of myalgia and purpura. Approximately 10 blue, itchy lesions with a maximum size of 36 cm^2 on the shoulders, arms, and legs were discovered	Sesame oil 10 mL	Oral corticosteroids for 2 weeks and high-dose morphine injections to control pain	After 4 weeks, recovery was complete

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Iversen, et al (13)	2009	Denmark	21	M, 23	1.5 years	Ulcers, pain, malaise, and fever. Skin red, swollen, and indurated. Enlarged painless lymphatic nodes in the neck	Paraffin oil 20 mL	Dicloxacillin and compression bandage from wrists to shoulders	A positive result from treatment. However, several sore firm masses on both arms developed.
Henriksen, et al (10)	2010	Denmark	24	M, 24	1 month	Skin inflammation, hard edema, sterile abscesses, diffuse lymphangitis, and paraffinomas	Paraffin oil 1 L in each arm	Compression bandages and antibiotics	Long-term adverse effects, including edema due to lymphatic decomposition and varying degrees of paraffinomas that migrated lymphatic and along fascia
Banke, et al (1)	2012	Germany	32	M, 40	8 years	Systemic infection and painful, reddened swellings of the right upper arm	Sterilized sesame seed oil Amount NR	Surgery	Persistent pain and inability to perform normal weight training were evident for at least 3 years post-surgery
Maatouk, et al (15)	2012	France	22	M, 25	3 years	Abscess, redness of the skin, pain, inflammation	Synthol oil Amount NR	Amoxicillin	Cured
Ghandourah, et al (8)	2012	Germany	24	M, 29	5 years	Painful pressure in right upper arm. On presentation, muscle appeared disfigured	Synthol oil 3 mL×16 injections	Open surgical excision of the anterior third of biceps was carried out through an anterior bicipital approach	Two weeks postoperatively, the patient was satisfied with the outcome. No adverse effects after surgery were reported. After 6 months, the patient requested the same procedure to be done on left biceps.
AbdullGaffar (5)	2014	United Arab Emirates	30	M, 32	2 years	Hard, nontender lump	Silicon Amount NR	NR	NR

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Table 1 ***(continued).*** Studies describing the use of site enhancement oils

Ikander, et al (12)	2015	Denmark	40?	M, 45	Few years	Patient's arms were rock solid and clearly deformed. Years after the injections, the patient suffered from spontaneous ulcerations on both arms	Synthol and paraffin oil	Conservative wound treatment with antibiotics and compression therapy for the right arm. The left arm needed surgical revision and negative pressure wound therapy, preparing the tissue for a split skin graft.	Good effect on the ulcers of the right arm
Hjort, et al (11)	2015	Denmark	35?	M, 40	Several years	Tachypnea, tachycardia, fever, and anemia subacute (fat-embolism–like syndrome)	Mineral oil with added anabolic steroids 140 mL	Respiratory supportive care and treatment with tranexamic acid, 1,000 mg 4 times daily, and prednisolone, 50 mg per day	At a clinical follow-up 3 months later, the patient experienced only mild dyspnea on exertion. Chest radiograph and CT showed complete remission of the bilateral infiltrates
Petersen, et al (17)	2015	Denmark	NR	M, 42	NR	Muscles, fascia, and surrounding subcutaneous fat tissue appeared inflamed and edematous	Site enhancement oil (not specified) Amount NR	NR	NR
Hameed, et al (9)	2016	United Kingdom	NR	M, 25	NR	Right arm pain and loss of function. Complete triceps rupture and multiple cystic areas within the muscles of the arm	Coconut oil Amount NR	Right triceps tendon repair at its distal insertion with allograft augmentation	Cured
Dejanovic and Loft (2)	2017	Denmark	NR	M, 50	NR	Inflammation, muscle atrophy, formation of oil-containing granulomas, hypercalcemia, and renal insufficiency	Site enhancement oil (not specified) Amount NR	NR	NR

Abbreviations: CT, computed tomography; M, male; NR, not reported.

called *Swiss cheese pattern* with macrophages and fibrous tissue (7, 13).

It has been described that inflammation is the first sign of foreign-body reaction that appears, usually 1 to 6 months after injection. After a period of latency, ulcerations and fistulas develop in the superficial plane, but oil diffusion to deeper planes, such as the reticular dermis, may lead to lipogranulomas, which are oleoma formations in perivascular fat and perimuscular fat that cause replacement of the subcutaneous fat with oil dispersed within fibrous tissue (6, 10).

Magnetic resonance imaging is the preferred imaging study that is commonly used to confirm the diagnosis and resolution of the adverse effects, especially when lipogranulomatosis occurs (18). However, ultrasound could be useful to determine the presence of the fluid inside the lesion.

Several complications after the use of SEOs can appear over time, like granulomatous lesions, ulcerations, disfigurement, erratic migration of the oil, pulmonary embolism, and death (Table 1) (3). Moreover, systemic reactions could occur over time in people who use SEOs. Hypercalcemia due to foreign-body reaction has been described in patients abusing SEOs (2, 21, 22). Systemic distribution has been reported to result in pulmonary adverse effects (16).

There is no specific treatment to remove oil from tissues; a treatment aim is to hold diffusion of the substance to stop the dissemination to deeper tissues and other nearby organs. The first therapy given to patients consists of antibiotics and steroids during the acute inflammation phase (16). Surgical treatment may be an effective treatment modality. In an acute phase of the disease, surgical excision of the damaged tissue might help to remove the excessive oil deposits and the affected areas when there is a suspicious of lipogranulomas (6, 18).

Nevertheless, conservative treatment should be considered when there is a widespread distribution of the oil (13). Iversen et al. described the use of compression bandages on ulcers caused by oil injections, suggesting the improvement in circulation and reduction of the edema due to the shorter distance between skin and capillaries (13). Compression therapy was also applied by Henriksen et al and Ikander et al. with good results (10, 12).

Additional aggressive surgical procedures should be avoided because of the risk of damaging nearby tissues, worsening chronic injuries, and predisposing to large scars (10). Therefore, in chronic stages, conservative surgical procedures might be performed evaluating the risks and benefits over the condition of the patient and the possibility to improve function and pain if any tissue was damaged (8, 9).

It is unclear if some of these substances are more harmful than others or have a different complication pattern or treatment strategy, and this is not known at this point given the relative dearth of information published on the topic.

Conclusions

The use of oils injections to muscles for cosmetic reasons is a dangerous practice. Medical and sports communities should be aware. The adverse effects associated with the injection of SEOs are not predictable, ranging from mild to life-threatening complications. Diagnosis and treatment should be performed early in order to prevent severe complications.

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