

Cutaneous Metaplastic Synovial Cyst: A Case Report and Literature Review

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Abstract

Introduction: Cutaneous metaplastic synovial cyst (CMSC) is a rare cutaneous lesion characterized by a tender subcutaneous nodule, which usually occurs at the site of previous surgical or local trauma. Histologically, the lesion includes a cystic structure with villous-like projections and a lining mimicking hyperplastic synovium.

Case Presentation: We reported the first case of CMSC which developed at the surgical incision site of treatment of a maxillofacial fracture. In addition, we reviewed English literature to evaluate all previously reported CMSC cases and discussed its clinical and histopathological features and etiology. From 1987 to now, reviewing the English literature about CMSC includes 17 studies that described 28 cases, and our presented case was the 29th. There was no sex predilection and age of patients ranged from 7 to 82 years, but most of them were over 40 years. We can see this lesion in any site of the body and hand/arm is the most prevalent involved region (28% cases). Most of the patients had a history of previous local trauma or operation in the involved area.

Conclusions: Although the actual etiology of CMSC remains unclear, trauma, as the most probable etiologic factor, plays a role in development of CMSC. Surgical excision of the lesion is the preferable treatment choice and rate of recurrence is low.

Keywords: Metaplasia, Mandibular Fractures, Wounds and Injuries, Synovial Cyst, Skin

1. Introduction

Cutaneous metaplastic synovial cyst (CMSC) is a rare intradermal cystic lesion lined with metaplastic synovial tissue composed of multiple intracystic villi mimicking hyperplastic synovial villi (1, 2), which was first described by Gonzalez et al. (3). There are only 28 reported cases in the English literature; five of them were located in the head and neck region (1, 4-6). Clinically, the lesion is a solitary tender, subcutaneous nodule usually found at the site of previous surgical skin trauma and frequently misdiagnosed as a suture granuloma (1, 7-10). Since most reported cases of CMSC have a history of previous skin trauma or surgical intervention and scar formation, local trauma in any form seems to be a primary etiologic factor. However, there are some reported cases without any clear history of trauma or antecedent surgery in the involved area, which cast doubt on its etiology (3, 9, 11-13).

2. Case Presentation

Herein, we reported a new case of CMSC in a patient with previous facial trauma causing mandibular angle fracture. This is the first reported case of CMSC following mal-treatment of maxillofacial bone fracture and presenting a new complication of surgical treatment of mandibular fracture via extra-oral incision. Finally, we tried to find out

etiologic factor of this pathologic lesion and reviewing the literature to better cognition of this rare entity.

2.1. Clinical Report

A 29 year-old white male presented to the department of Oral and Maxillofacial Surgery, Taleghani Hospital, Tehran, Iran, with a soft cystic mass of the right submandibular region, overlying the mandibular angle at the inferior border (Figure 1). He had no medical or familial history of systemic disease and his general status was good. He had a previous history of sports trauma 8 years prior (hit with baseball bat) leading to right mandibular angle and symphysis fractures. The angle fracture had been treated via an extraoral submandibular incision and on the other side the symphysis fracture was treated intraorally. Both fractures were fixed with two mini plates after reduction and postoperative course was uneventful; two years after mandibular fracture treatment, a pathologic mass developed at the site of primary surgery over the right mandibular angle. The pathologic mass was surgically excised. It was a cystic lesion histologically reported as a synovial cyst. Over the next years, the swelling gradually reappeared at the previous site and patient was referred to us. On physical examination, a 2 × 4 cm subcutane-

ous, soft, mobile mass in submandibular region above the previous surgical scar was noted. The overlying skin was erythematous, but there was no lymphadenopathy, fistula or any signs of infection. The fixation device in the mandibular angle region was dislodged from the inferior border, and was palpable and clearly visible on the

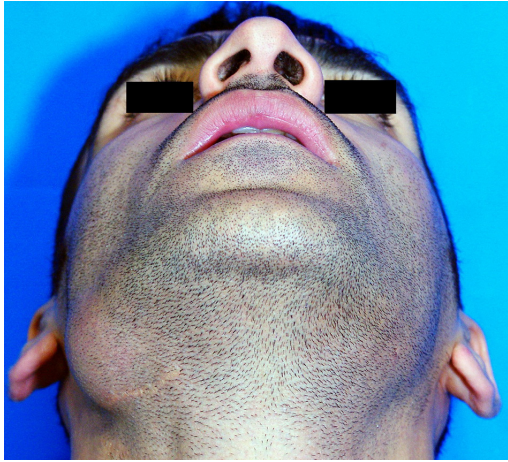


Figure 1. Preoperative Photograph of the Patient With a Soft Fluctuant Swelling on the Right Submandibular Region

panoramic radiograph (Figure 2). Magnetic resonance imaging of the neck showed a hyperintense heterogeneous mass on T2-weighted images with a well-defined border like a cystic or capsulated lesion. On T1-weighted images, it had a hypointense appearance, the confines of which were not as clear as T2-weighted images (Figure 3).

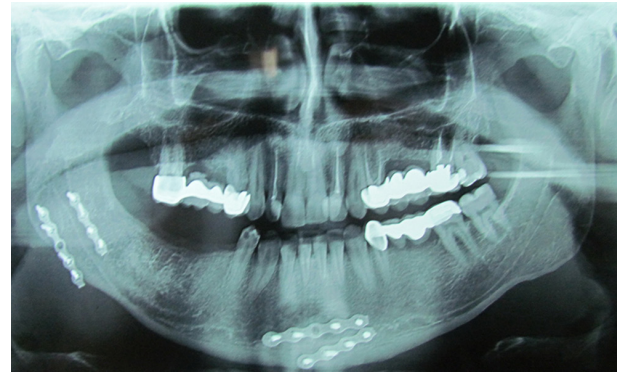
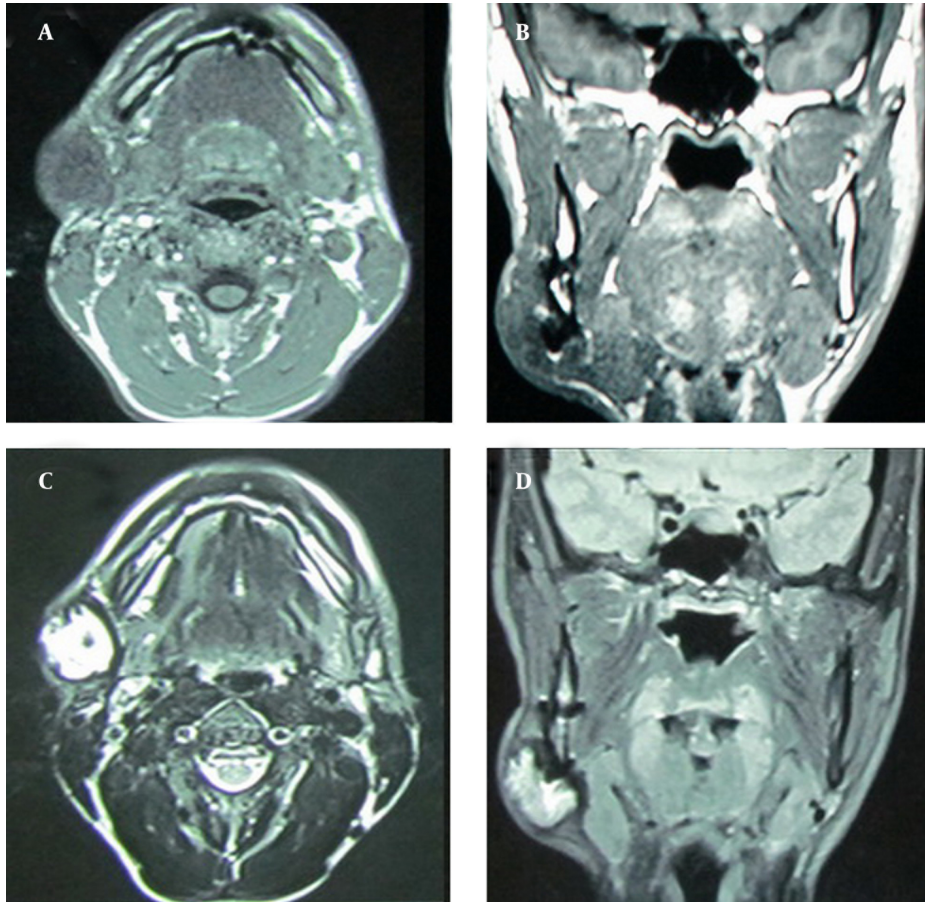
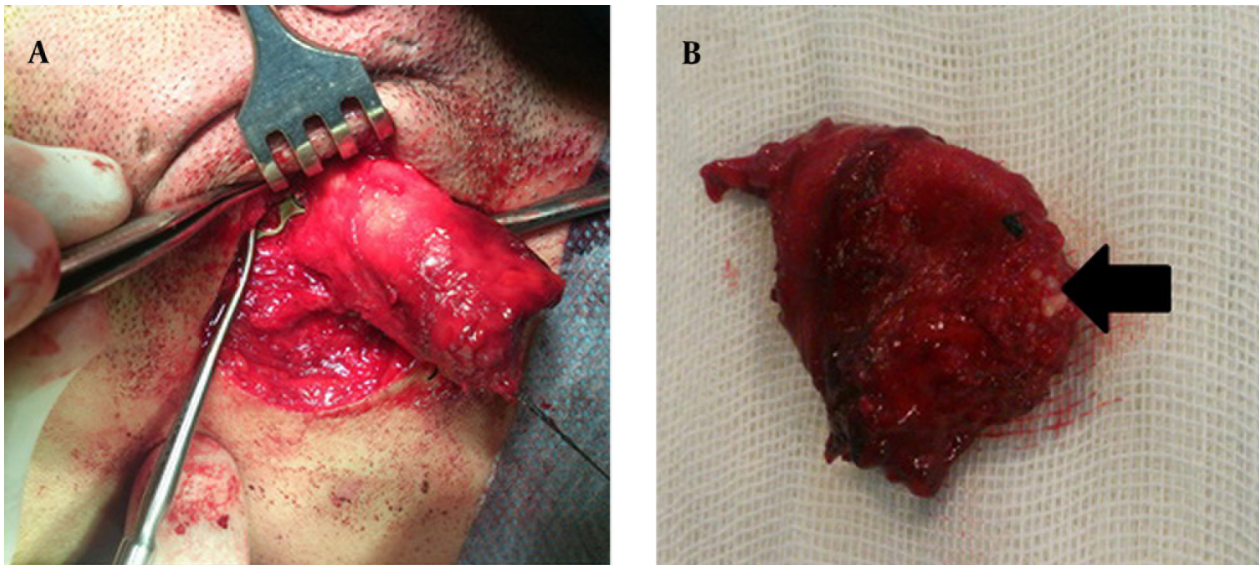


Figure 2. Panoramic Radiograph of the Patient Showing Maladaptive Fixation Device (mini-plate) in the Right Mandibular Inferior Border

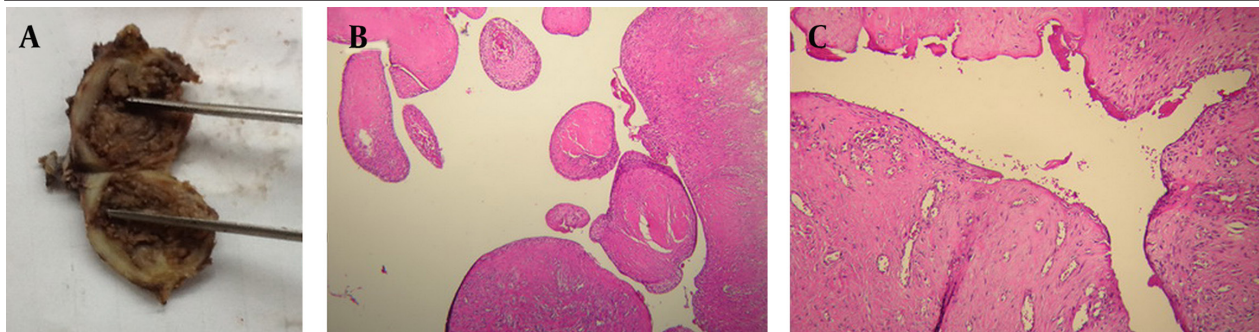
Figure 3. Preoperative MRI of the Patient



A, T1-weighted axial view; B, T1-weighted coronal view; C, T2-weighted axial view; D, T2-weighted coronal view.

Figure 4. Intra-Operative View of the Lesion

A: Intra-operative View of the Lesion With Tight Adhesion to Surrounding Tissues; B: View of the Excised Lesion Containing Spherical Particles or Derbies (black arrow).

Figure 5. Histopathologic View of the Lesion

A: The resected specimen showing a cystic structure with intraluminal papillary projections and loose central debris. It has a well-defined, firm, fibrous pseudocapsule; B, C: Photomicrograph of the lesion demonstrating cystic cavity containing villous structures lined by membrane resembling hyperplastic synovium (H&E; $\times 40$, $\times 100$).

Considering clinical and radiographic features of the lesion, probable differential diagnoses were epidermoid cyst, dermoid cyst and foreign body granuloma. Total excision of the lesion was performed via a submandibular incision through the previous scar. Dissection was performed along the capsule-like fibrous tissue of the lesion; although it was difficult due to its adhesion to the surrounding skin (Figure 4A). After excision of the lesion, the inferior mini-plate in the mandibular angle was removed, because it was separated from the inferior border of the mandible. Macroscopic feature of the specimen showed a cystic lesion with firm fibrous connective tissue resembling a pseudocapsule with intracystic papillary projections. It contained loose central white spherical particles or debris like "a bag of pearls" (Figure 4B). Histopathological examination revealed a cystic structure with multiple intraluminal villous projections lined by a membrane resembling hyperplastic synovium with a variety of cellular structures (Figure 5). These findings confirmed the diagnosis of cuta-

neous metaplastic synovial cyst. One-year follow-up visits showed no evidence of recurrence or complications.

3. Discussion

All the reported cases of CMSC from 1987 which were first described and nominated by Gonzalez et al. (3) were studied in this review. Data collection was performed from databases including PubMed, EMBASE, ISI Web of science, Scopus, Google Scholar and our presented case report. To date, 17 studies were available in the English literature, which described 28 cases; considering our case, 29 cases included in this review. Inclusion criteria were all cases of CMSC described in case reports and literature review studies and clearly included the description of this lesion clinically and histopathologically. We considered all clinically, demographic and immunohistochemical features of this lesion and companionship with other lesions and also history of previous trauma.

Table 1. Clinical Features of Reported Cutaneous Metaplastic Synovial Cysts^a

Reported Cases	Age, y/Sex	Anatomic Location	Clinical Feature of the Lesion	Preexisting Lesion and Associated Condition	History of Preceding Trauma
Gonzalez et al. (3)					
Case 1	82/F	Anterior chest	Tender, erythematous nodule, 0.4 cm	Surgical scar	Surgery for pacemaker placement
Case 2	27/F	Abdomen	Tender, erythematous nodule, 0.6 cm	Surgical scar	Appendectomy
Case 3	77/M	Abdomen	Tender, erythematous nodule, 0.7 cm	Surgical scar	Laparotomy for small bowel obstruction
Stern and Sexton (14)	7/F	Scalp	Skin ulcer	Surgical scar, Nevus sebaceous	Excision of pathologic lesion, Insertion of tissue expander
Gomez Dorronsoro et al. (10)	28/M	Upper arm	Dermal lesion	Surgical scar	Skin biopsy
Bhawan et al. (6)					
Case 1	40/M	Index finger	NA	None	None (patient was a fisherman)
Case 2	40/F	Palm	NA	Puncture wound	Wound by splinter
Case 3	20/M	Abdomen	NA	Surgical scar	Laparotomy
Case 4	67/M	Face	NA	Basal cell carcinoma	None
Beham et al. (15)					
Case 1	45/F	Dorsum of hand	Nodule, 0.8 cm	Burn scar	Burn
Case 2	15/F	Knee	Deep dermal lesion	Hard foreign body (maybe stone) in cyst cavity	Trauma to the knee joint
Nieto et al. (13)	15/F	Elbow	Mobile asymptomatic skin-colored nodule, 1.7 × 1.2 cm nodule	Ehlers-Danlos syndrome	None
Singh et al. (7)	72/M	Buttock	Multiple tender, cystic nodules with serosanguinous drainage	Rheumatoid arthritis	None (patient was wheelchair user)
Choonhakarn et al. (9)					
Case 1	55/F	Volar aspect of great toe	Asymptomatic, skin-colored nodule	Rheumatoid arthritis	None
Case 2	46/M	Volar aspect of Thumb	Asymptomatic, skin-colored nodule	Rheumatoid arthritis	None
Lin et al. (16)	61/F	Buttock	Palm-sized ill-defined reddish brown deep nodule with central scar and serosanguinous drainage	Surgical scar for excision of epidemoid cyst	Excisional surgery, incision and drainage
Yang et al. (17)	80/F	Buttock	Asymptomatic, grouped, noninflamed, mobile noduloplaques	Degenerative spondylosis	None
Goiriz et al. (11)					
Case 1	64/F	Wrist	Violaceous, painful, nodule, 0.7 cm	None	Falling trauma
Case 2	63/F	Finger	Erythematous painful nodules, 0.4 cm	Arthrosis	None
Case 3	51/M	Foot	Violaceous asymptomatic nodule, 1 cm	None	None
Case 4	35/F	Abdomen	Erythematous asymptomatic nodule, 0.5 cm	Surgical scar	Laparotomy

Case 5	60/M	Abdomen	Erythematous painful nodule, 1 cm	Surgical scar	Excision of a dermatofibrosarcoma
Ramdial et al. (2)	23/M	Breast	Painless firm swelling, 6 × 4 × 4 cm	Surgical scar, Gynecomastia	Mastectomy
Chakravarthy et al. (5)	31/M	Neck (submandibular region)	Fluctuant cystic swelling containing serosanguineous fluid, with recurrence	Surgical scar, epidermoid cyst, CMSC	Twice excision of epidermoid cyst and triple excision of CMSC
Guala et al. (12)	7/M	Knee	Mobile asymptomatic elastic nodule with thin pink translucent skin, 2 cm	Ehlers-Danlos syndrome	None
Inchingolo et al. (4)	26/F	Face (infrazygomatic region)	Painless nodule, 0.5 cm	hyaluronic acid filler injections	Injection of non-animal stabilized hyaluronic acid (NASHA)
Shim et al. (1)	18/M	Face (cheek region)	Tender nodule without erythema, containing serosanguinous fluid, 0.62 × 1.31 cm	None	Habitually skin manipulation by patient
Kim et al. (8)	51/F	First metatarsal head area	Solitary tender skin-color cystic mass, 3 × 3 cm	None	None
Present study	29/M	Face (mandibular inferior border)	Solitary cystic mass with erythematous, 2 × 4 cm, with recurrence	Surgical scar, CMSC	Mandibular angle osteosynthesis with submandibular incision approach

^aAbbreviation: NA, Not Available.

Cutaneous metaplastic synovial cyst is an extremely rare pathologic condition first described by Gonzalez et al. less than 3 decades ago. They reported 3 cases of synovial metaplasia in cystic structures that were formed intradermally in skin areas with history of previous surgical procedure (3). Up to now, reviewing the English Literature showed a few more reported cases including 17 studies which described 28 cases (Table 1).

Clinical features of the CMSC are usually as subcutaneous nodules or masses which vary in diameter between 0.4 - 6 cm (2, 11, 17). All the reported cases were solitary lesions except one which presented multiple tender, cystic nodules on both buttocks (7). These nodules can be tender or painless. Overlying skin had erythema in some cases. Occasionally, lesions drain serosanguinous fluid to surface epithelium or this fluid may be aspirated from cystic lesions (9, 17). Most patients had a history of previous local trauma or operation in the involved area and this lesion accompanied with other disorders including basal cell carcinoma, Ehlers-Danlos syndrome and rheumatoid arthritis (Table 1). Generally, there was no gender predilection in previous reported cases (15 females versus 13 males) (Table 1). Moreover, this lesion can appear in any site of the body including (Figure 6) hand/arm (8 cases), head/neck (6 cases), foot/leg (5 cases), abdomen (5 cases), buttock (3 cases) and chest (2 cases). This lesion was reported in a wide age range (7 to 82 years), but most patients were older than 40 years old (Table 1). In two reports, the reported lesions in a 7 and a 15 year-old patient were assumed to be a manifestation of Ehlers-Danlos Syndrome (12, 13). Although our patient was young, no signs of Ehlers-Danlos syndrome and related manifestations were found.

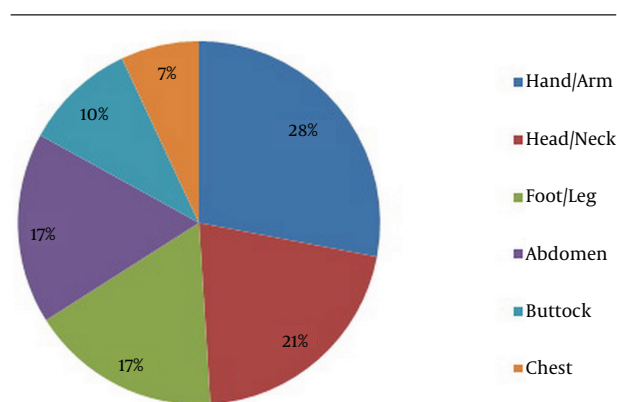


Figure 6. Distribution of Reported CMSC Cases According to the Sites of Involvement

Because of the presentation of CMSC in surgical scars (about 50% of the cases) and clinical similarity (such as erythematous, tender, subcutaneous nodule), it was frequently misdiagnosed as a suture granuloma. Furthermore, other cutaneous lesions like epidermal cyst, mucous cyst, foreign body granuloma and eccrine poroma are similar differential diagnoses. Correct diagnosis is possible only by histopathological evaluation (3, 6-9, 13-17).

Histologically, CMSC is not a true cyst, because it lacks an epithelial lining. This pseudocyst is characterized by a thin layer of cells that resemble a synovial membrane and contain multiple villous processes towards the center of the cyst cavity. This lining has variable cellularity from hypocellular to hypercellular areas. The hypercellular area consists of four zones which contain differ-

ent cells from the luminal zone to the outer zone. They include polymorphic epithelioid and multinucleated giant cells (zone 1 or luminal), lymphocytes, neutrophils and eosinophils (zone 2), vascular tissues (zone 3) and fibroconnective tissues (zone 4). The hypocellular area appears as an extensive zone of hyalinized connective tissue with fibrin deposition. The surrounding tissues (subcutaneous region) sometimes exhibit reactive changes such as fibrosis, which makes excision of this lesion difficult (2, 5, 7, 9).

Some of the specimens (18 cases) have been studied for immunohistochemical features of the CMSC and their results are presented in Table 2. All the studies showed positive staining against vimentin in all cell linings of the cyst wall, whereas stains for CD34, S-100, keratin, CEA, EMA and alpha-IAT had negative results. These findings support the mesenchymal origin of CMSC. On the other hand, the reaction to CD68 was negative in 4 studies (5 cases) and positive in 2 studies (3 cases) and this positive reaction was only to histiocyte of the cyst wall but not to the synovial lining. CD68 positive reaction is a common manifestation in normal synovium, but partial reaction to CD68 in some cases of CMSC can show only some structural similarity between normal synovium and CMSC. Therefore, we cannot consider the same origin and nature for them. In accordance with Bhawan et al. synovial metaplasia may be only unusual reactive process of connective tissue, which is induced by disruption of skin structures (3, 6, 9, 10, 13-17).

Understanding the etiology of CMSC depends on the cognition of synovial metaplasia. Synovial metaplasia is formation of synovial-like membrane structures in locations not intimately related to joint or tendon sheath areas (18). This phenomenon was first described by Selye

(19) and Edwards et al. (20) in experimental studies on reaction of subcutaneous tissues to injection of air and oil which developed synovial metaplasia. Since these experimental animal studies, some cases of synovial metaplasia in humans have been reported in association with joint and tendon prostheses, breast prostheses, testicular prostheses and scars of previous surgical incisions or otherwise traumatized skin, although the term "cutaneous metaplastic synovial cyst" refers to skin and subcutaneous lesions. It is hypothesized that these metaplastic synovial-like structures develop as a result of maturation of multi-potential surrounding connective tissue cells in response to tissue disruption. Disruption of connective tissue can entrap air or fluid in surgical wounds; also presence of foreign materials like sutures and orthopedic or breast prostheses may produce gliding trauma in dermal tissues, which stimulate formation of synovial metaplasia (18, 20, 21). This hypothesis can be confirmed by considering the embryological origin of normal synovium and its development. Although the embryological origin of synoviocytes of a normal synovium is controversial, it is suggested that epithelioid cells are derived from histiocytes of bone marrow, whereas fibroblasts are from local mesenchymal cells. In addition, the embryological origin of the normal synovium is a consequence of local mechanical disruption of connective tissue, which occurs when the embryo begins to move in vitro. Hence, it is possible that disruption of connective tissue as a result of air or oil injections, hyaluronic acid filler injections, orthopedic devices or prostheses, breast implants, surgical scars, or repetitive trauma stimulate the embryological process of connective tissue disruption and the potential to induce synovium-like membrane of a CMSC (1, 2, 4, 7, 9, 13, 18).

Table 2. Immunohistochemical Features of Reported Cutaneous Metaplastic Synovial Cysts^a

Reported study	Vimentin	CD68	CD34	S100	Keratin	CEA	EMA	Lysozyme	Alpha-IACT	Alpha-IAT
Gonzalez et al. (3)	+	ND	ND	-	-	-	-	±	±	-
Stern and Sexton (14)	+	ND	ND	-	-	-	ND	+	+	ND
Gomez Dorronsoro et al. (10)	+	ND	ND	-	-	-	-	-	-	-
Bhawan et al. (6)	+	ND	ND	-	-	-	-	-	-	-
Beham et al. (15)	+	-	ND	-	-	-	-	ND	ND	ND
Nieto et al. (13)	+	-	ND	ND	-	ND	ND	ND	ND	ND
Choonhakarn et al. (9)	+	+	ND	-	-	-	-	ND	ND	ND
Yang et al. (17)	+	+	ND	-	-	ND	ND	ND	ND	ND
Ramdial et al. (2)	+	ND	ND	-	ND	-	-	ND	ND	ND
Chakravarthy et al. (5)	+	-	-	ND	-	ND	ND	ND	ND	ND
Kim et al. (8)	+	-	-	ND	ND	ND	ND	ND	ND	ND

^aAbbreviations: Alpha-IACT, α -1-antichymotrypsin; Alpha-IAT, α -1-antitrypsin; CEA, Carcinoembryonic Antigen; EMA; epithelial membrane antigen; ND, Not Done; ±, Scattered positivity.

Although local trauma was considered as a primary cause of CMSC, there are some reports of CMSC develop-

ment without any history of previous trauma or surgery in the involved area. These cases of CMSC without local trauma were seen in 11 of 29 reported cases. However, two of the cases were associated with Ehlers-Danlos syndrome, which causes cutaneous fragility and abnormal scarring; thus we can expect development of this lesion even after insensible microtrauma. Furthermore, five other patients in this group had lesions accompanied by rheumatoid arthritis, arthrosis or degenerative spondylosis, which cause chronic inflammation, produce constant pressure and repeated mechanical disruption from rehabilitating devices like wheelchairs, predisposing patient to develop CMSC. A few patients remained who did not have any history of trauma or predisposing factors for development of CSMC, but even in these cases, the lesions had developed in areas where usually heavy pressure is applied (index finger of a fisherman, first metatarsal head area and foot) (7-9, 13).

Considering the benign behavior of CMSC, treatment of choice is excisional surgery. Once the lesion has been excised, its recurrence is rare and only two cases had recurrence, one of them was our patient. We believed that recurrence in this case was due to maladaptive mini-plate osteosynthesis device (as a local constant traumatic factor), which predisposed to recurrence of the lesion (5, 8, 9, 17).

Trauma as a significant etiology of health problems affects nearly every population in the world (22). One of the rare consequences of trauma can be cutaneous metaplastic synovial cyst (CMSC), which is a recently described cutaneous lesion characterized by a tender subcutaneous nodule and usually occurs at the site of previous surgery or local trauma. Although the actual cause remains unclear, trauma as the most probable etiologic factor plays a role in development of CMSC by mechanical disruption of underlying connective tissue.

Considering benign behavior of CSMC and low recurrence rate of this lesion, the best treatment modality is simple surgical excision of the cyst and elimination of possible local trauma to the involved areas.

Footnote

Authors' Contribution: Nima Dehghani, Siavash Dehghani and Nima Sadeghi: data collection and writing the manuscript; Hamed Kermani, Hossein Behnia, Fereydoun Pourdanesh, and Hassan Mohajerani: contributed to treatment of the patient.

References

1. Shim WH, Jwa SW, Song M, Kim HS, Ko HC, Kim BS, et al. Cutaneous metaplastic synovial cyst of the cheek generated by repetitive minor trauma. *Ann Dermatol*. 2011;**23**(Suppl 2):S235-8. doi: 10.5021/ad.2011.23.S2.S235. [PubMed: 22148059]
2. Ramdial PK, Singh Y, Singh B. Metaplastic synovial cyst in male breast. *Ann Diagn Pathol*. 2005;**9**(4):219-22. doi: 10.1016/j.anndiagn-path.2005.04.009. [PubMed: 16084456]
3. Gonzalez JG, Ghiselli RW, Santa Cruz DJ. Synovial metaplasia of the skin. *Am J Surg Pathol*. 1987;**11**(5):343-50. [PubMed: 3578644]

4. Inchingolo F, Tatullo M, Abenavoli FM, Marrelli M, Inchingolo AD, Servili A, et al. A hypothetical correlation between hyaluronic acid gel and development of cutaneous metaplastic synovial cyst. *Head Face Med*. 2010;**6**:13. doi: 10.1186/1746-160X-6-13. [PubMed: 20633261]
5. Chakravarthy KM, Lavery KM, Barrett AW. Recurrent cutaneous metaplastic synovial cyst. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod*. 2007;**103**(4):e42-4. doi: 10.1016/j.tripleo.2006.02.026. [PubMed: 17395059]
6. Bhawan J, Dayal Y, Gonzalez-Serva A, Eisen R. Cutaneous metaplastic synovial cyst. *J Cutan Pathol*. 1990;**17**(1):22-6. [PubMed: 2319036]
7. Singh SR, Ma AS, Dixon A. Multiple cutaneous metaplastic synovial cysts. *J Am Acad Dermatol*. 1999;**41**(2 Pt 2):330-2. [PubMed: 10426923]
8. Kim BC, Choi WJ, Park EJ, Kwon IH, Cho HJ, Kim KH, et al. Cutaneous metaplastic synovial cyst of the first metatarsal head area. *Ann Dermatol*. 2011;**23**(Suppl 2):S165-8. doi: 10.5021/ad.2011.23.S2.S165. [PubMed: 22148041]
9. Choonhakarn C, Tang S. Cutaneous metaplastic synovial cyst. *J Dermatol*. 2003;**30**(6):480-4. [PubMed: 12810997]
10. Gomez Dorransoro ML, Martinez-Penuela JM, Ruiz de la Hermosa J. Metaplastic synovial cyst. *Am J Surg Pathol*. 1988;**12**(8):649-50. [PubMed: 3400795]
11. Goiriz R, Rios-Buceta L, Alonso-Perez A, Jones-Caballero M, Fraga J, Garcia-Diez A. Cutaneous metaplastic synovial cyst. *J Am Acad Dermatol*. 2005;**53**(1):180-1. doi: 10.1016/j.jaad.2005.01.132. [PubMed: 15965452]
12. Guala A, Viglio S, Ottinetti A, Angeli G, Canova G, Colombo E, et al. Cutaneous metaplastic synovial cyst in Ehlers-Danlos syndrome: report of a second case. *Am J Dermatopathol*. 2008;**30**(1):59-61. doi: 10.1097/DAD.0b013e31815b9c82. [PubMed: 18212547]
13. Nieto S, Buezo GF, Jones-Caballero M, Fraga J. Cutaneous metaplastic synovial cyst in an Ehlers-Danlos patient. *Am J Dermatopathol*. 1997;**19**(4):407-10. [PubMed: 9261479]
14. Stern DR, Sexton FM. Metaplastic synovial cyst after partial excision of nevus sebaceus. *Am J Dermatopathol*. 1988;**10**(6):531-5. [PubMed: 3218721]
15. Beham A, Fletcher CD, Feichtinger J, Zelger B, Schmid C, Humer U. Synovial metaplasia of the skin. *Virchows Arch A Pathol Anat Histopathol*. 1993;**423**(4):315-8. [PubMed: 8236828]
16. Lin YC, Tsai TF. Cutaneous metaplastic synovial cyst: unusual presentation with "a bag of worms". *Dermatol Surg*. 2003;**29**(2):198-200. [PubMed: 12562356]
17. Yang HC, Tsai YJ, Hu SL, Wu YY. Cutaneous Metaplastic Synovial Cyst-A Case Report and Review of Literature. *Dermatol Sinica*. 2003;**21**(3):275-9.
18. Fowler MR, Nathan CO, Abreo F. Synovial metaplasia, a specialized form of repair. *Arch Pathol Lab Med*. 2002;**126**(6):727-30. doi: 10.1043/0003-9985(2002)126<0727:SMASFO>2.0.CO;2. [PubMed: 12033966]
19. Selye H. On the mechanism through which hydrocortisone affects the resistance of tissues to injury; an experimental study with the granuloma pouch technique. *J Am Med Assoc*. 1953;**152**(13):1207-13. [PubMed: 13061241]
20. Edwards JC, Sedgwick AD, Willoughby DA. The formation of a structure with the features of synovial lining by subcutaneous injection of air: an in vivo tissue culture system. *J Pathol*. 1981;**134**(2):147-56. doi: 10.1002/path.1711340205. [PubMed: 7019400]
21. Chi AC, Haigney RJ, Spagnoli DB, Neville BW, Richardson MS. Papillary synovial metaplasia-like change in oral mucocoeles: a rare and previously undescribed histopathologic variant of a common oral lesion. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod*. 2010;**109**(2):268-73. doi: 10.1016/j.tripleo.2009.09.018. [PubMed: 19969479]
22. Sadeghi-Bazargani H, Azami-Aghdash S, Ziapour B, Deljavan R. Trauma-related Therapeutic Procedures at Shohada Trauma Center in Tabriz. *Trauma Mon*. 2013;**17**(4):389-92. doi: 10.5812/traumamon.7737. [PubMed: 24350134]