A Strategic Approach to Enhancing the Efficacy of Volume Augmentation in Poland’s Syndrome using Microautologous Fat Transplantation

— A Case Report

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Background:

Poland’s syndrome is classically defined as ipsilateral agenesis of the pectoralis major muscle and can be associated with hand anomalies (syndactyly). Surgical intervention for patients with Poland’s syndrome is determined according to functional and aesthetic problems as well as patients¹ age and sex. Given its etiology and vascular insult during embryogenesis, fat grafting and graft take can be suboptimal and often requires multiple repeated procedures.

Aim and Objectives:

We share our experience using microautologous fat transplantation (MAFT) on the treatment of a patient with Poland’s syndrome. There is a paucity of literature describing this technique for volume augmentation in a patient with Poland’s syndrome and most cases described utilize conventional fat grafting techniques. This hence represents a case of chest wall augmentation using the MAFT technique.

Methods:

A 61-year-old man with mild form of Poland’s syndrome was treated with microautologous fat transplantation for irregular and sunken appearance of left chest wall. A MAFT-Gun device was used for fat injection.

Results:

The sunken appearance of the left chest wall was significantly improved after 2 sessions of autologous fat injections. Bilateral chest wall appeared symmetric in comparison. There was no surgical complication or donor site morbidity. The patient was satisfied with the good aesthetic outcome.

Conclusion:

Microautologous fat transplantation can form one of the treatment modalities for Poland’s syndrome with various degrees of deformity. It can be used alone or
combined with other reconstructive strategies. It provides a significantly improved aesthetic outcome associated with low morbidity and high efficacy. (J Taiwan Soc of Plast Surg 2016;25:339～347)

Key words: poland’s syndrome, fat grafts, MAFT, MAFT-Gun

Introduction

Poland’s syndrome is classically defined as ipsilateral agenesis of the pectoralis major muscle associated with hand anomalies (syndactyly). Other minor criteria of the syndrome are absence or hypoplasia of the pectoralis minor muscle, agenesis of the costal cartilages, absence of the anterior parts of the ribs, anomalies of the breast and nipple, a lack of subcutaneous tissue and pectoral or axillary alopecia. It was firstly described by Alfred Poland in 1841. The incidence rate of Poland’s syndrome ranges from 1:10,000 to 1:100,000 in different studies. Most cases are sporadic, and cases of familial inheritance are extremely rare. The incidence is higher in men, with a ratio of 3:1. The right chest wall is affected twice as often as the left. Although Poland’s syndrome usually is unilateral in its presentation, bilateral symptoms have been reported in a small proportion of patients.

The exact etiology of this syndrome remains unclear. Different etiologic factors of the Poland’s syndrome are taken into account: genetic, vascular disruption during embryogenesis and also teratogenic effects (e.g., cigarette smoking during pregnancy, viral infections). However, the vascular disruption during embryogenesis is considered to be the most agreeable etiology by most of the authors. The vascular differentiation from six aortic arches begins at the sixth week of gestation. At the same time period, the pectoral mass starts to develop, becoming future muscles of the thorax as intervening tissue between the finger rays of hands begins to disappear. An interruption of the early embryonic blood supply in the subclavian arteries, vertebral arteries and/or their branches may give rise to under development of chest wall and hand.

Poland’s syndrome is characterized by multiple anomalies resulting in complex anatomical defects and as such, a variety of surgical techniques have been described to address various deformities within the spectrum of the syndrome. Microautologous fat transplantation can form one of the treatment modalities to improve the contour and augment the soft tissue defect on the chest wall. Here we present our experience of this technique in a clinical case of a man with Poland’s syndrome who was treated using this technique.

Methods

We retrospectively reviewed the medical records of a 61-year-old man with Poland’s syndrome, who had hypoplasia of left pectoralis major muscle and nipple (Fig.1, a and b). He was treated in our department with 2 sessions of microautologous fat transplantation over his left chest wall on 18 January and 9 August in 2014.

Fat Grafts Harvesting

Autologous fat was harvested using a syringe from the anterior abdomen and bilateral flank region under local anesthesia with the patient in a supine position. We used Hunstad’s formula as the tumescent solution at a ratio of Ringer’s lactate solution: 1% lidocaine: epinephrine (1:1000) = 1000ml: 50ml: 1ml for fat harvesting. Initially, the injection site was infiltrated with 1cc of 0.5% lidocaine. After making a 3mm cut using No.11 blade on the injection site, tumescent solution was infiltrated throughout the anterior abdomen and bilateral flank region gently and slowly using a 1.5 mm diameter cannula. After the tumescent solution was administrated for 5-10 min, the patient is checked for complete anesthesia before fat harvest is begun. Then a 3mm diameter blunt tip cannula was used to harvest the fat graft. About 5-10 ml negative suction was applied on a 10-ml Luer-Lok syringe plunger. The
Syringes of harvested fat were kept in an upright position for several minutes to decant the aqueous fluids at the bottom.

**Fat Grafts Processing and Transfer**

We used a sieve and multiple-layer gauze filtration method for fat processing. The lipoaspirate was poured on the microporous mesh and a thick layer of gauze. It was washed with equal amount of normal saline to remove the blood components. The residual aqueous fluid was removed using capillary action. While the fat grafts are being processed by other surgical team members, 0.5% lidocaine (~30cc) is infiltrated throughout the left chest wall before the fat grafts are transferred. Carefully check with the patient for complete anesthesia of the left chest wall before the fat is injected. This is mandatory because the fat grafting procedure is performed under local anesthesia and has to ensure there is no uncomfortable condition from the patient during the whole process.

A concept of microautologous fat transplantation (MAFT) with the application of MAFT-Gun, which is designed by Lin, was used for fat graft transfer. The filtered fat was filled into a syringe, which was then loaded into the MAFT-Gun. The volume of fat parcels to be injected during each trigger was adjusted by rotating the dial on the MAFT-Gun, which label the numbers of total injection frequencies per 1ml of fat graft. In our case, the injection frequencies we set were 60 triggers per 1ml (0.017cc per trigger). A 2mm blunt cannula was attached to MAFT-Gun and used to inject the fat.

The fat grafts were delivered using ‘Reverse Liposuction’ and ‘Mapping’ technique and was meticulously injected into multiple layers on left chest wall just below the dermis. About 135cc and 45cc of fat grafts were delivered in two different sessions with 7 months intervals in between. Postoperative care was simple without any dressing and massage. Oral antibiotics and analgesics were prescribed for 3 days. Patient was followed regularly at our clinics and postoperative chest wall appearance was photographed. The preoperative and postoperative photographs along with computed tomography images are presented in this article for comparison.

**Results**

After the patient received the first session of microautologous fat transplantation, his left chest wall was restored to a more natural contour (Fig.1, c and d). The patient was then satisfied with the restoration of fullness of the left chest wall. He further requested a second session of MAFT for restoration of the contour and appearance of the pectoralis muscle.

At 16 months follow up after the second session of MAFT, his left chest wall fullness and contour was similar to the right side (Fig.1, e and f). A 17-month postoperative computed tomography showed an increase in the thickness of his left chest wall after 2 sessions of MAFT (Fig. 2). No recipient complication or donor morbidity was encountered during these 2 sessions of MAFT.

**Discussion**

Surgical intervention for patients with Poland’s syndrome is determined according to functional and aesthetic problems as well as patients’ age and sex. However, most patients seek surgical intervention to correct their thoracic wall deformity because of their concern for aesthetic problems. Any surgical procedure is usually delayed for patients with no life-threatening deformities and when growth has been completed. In our case, this 61 year old male patient requested an improvement of his sunken left chest wall because of the embarrassed and stigma given by others regarding his asymmetric appearance of the bilateral chest wall. He did not desire any major or complicated reconstructive surgery to correct his left chest wall deformity. Therefore, autologous fat grafting is the best reconstructive option for him.

Foucras et al. proposed in 2003 a classification of chest wall and breast deformities into three grades. Seyfer et al. proposed in 2010 two anatomical forms of Poland’s syndrome: simple and complex form. Regardless of which clinical classification used, appropriate treatment can be tailored according to the
Fig. 1. A 61-year-old man has Poland’s syndrome characterized with hypoplasia of left pectoralis major and nipple. Preoperative view of asymmetric chest wall appearance (a,b). Postoperative result at 7 months after first session of fat injection about 135cc to fill the hollow of left chest wall (c,d). Postoperative result at 16 months after second session of fat injection about 45cc to fill the hollow of left chest wall (e,f).
degree of involvement. Treatment modalities include autologous fat grafting, insertion of breast implant or tissue expander, local tissue or free tissue transfer. Fatah et al. proposed in 2015 an algorithmic approach to Poland's syndrome based on 20 years follow-up of 37 patients. His study showed good subjective and objective aesthetic results for the treatment of various degree of Poland's syndrome. Our patient belonged to Grade I deformity (Foucras’s Classification), which is characterized with hypoplasia of pectoralis major and other chest wall muscles resulting in minor asymmetry of chest wall. Among the surgical techniques, which have been proposed in Poland’s syndrome, autologous fat grafting would be the best surgical option, particularly because of the possibilities it offers for volume augmentation, filling the defect to correct the contour deformity, restoring tissue suppleness, and also because of its low morbidity. Autologous fat injection can be used alone, or combined with other reconstruction modalities in all grades of Poland’s syndrome.

Fat graft survival rate is directly related to the fat harvesting, processing and transfer technique. The most common and well-established fat harvesting technique is the Coleman technique. In Coleman’s studies, his technique of fat harvesting and processing resulted in a greater number of viable adipocytes which was able to sustain more optimal cellular function than fat grafts harvested with conventional liposuction. For fat harvesting, some authors advocate that it is essential to maintain a suitable negative pressure in order to minimize damage to the lipoaspirate. About 15-20 inches of mercury negative pressure is agreed amongst the majority of surgeons being safe without damage the lipocytes. However, there exists a contradictory opinion that no significant difference was found in adipocyte viability between different negative pressures. Coleman does not mention the recommended amount of negative pressure applied during fat harvest. He only mentions a slight negative pressure on a 10-ml syringe being adequate. We applied 5-10ml pull, which is equivalent to 6-10 inches of mercury pressure on the plunger of a 10-ml syringe during fat harvest. It is believed to be safe to preserve lipocytes.

For fat processing, Coleman mentioned 3000 rpm (revolution per minute) for 3 min in the lipoaspirate. In fact, RPM is actually not a constant unit of measure. This is because the force varies with the radius of centrifuge machine (the bigger the radius, the more acceleration applied to samples for the same RPM). Regarding the amount of centripetal force, g should be
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the correct term (the capital G is not the correct unit) as a unit for quantifying centrifuge, which refers to the acceleration applied to your samples (1000 g being equivalent to 1000 times gravity of Earth). Kurita, M et al. stated that centrifugation at more than 3000g significantly damaged adipose-derived stem cells. The recommended centrifugal force should be 1200g to avoid destroying the lipocytes21. Nowadays, some surgeons do not employ the centrifuge method for fat processing. According to an autologous fat transfer national consensus survey in 2007, only 47% of the surgeons from the American Society for Aesthetic Plastic Surgery centrifuge the fat graft, as Coleman described22. This result reflects the fact that other fat processing methods can also achieve good graft survival. Smith, P et al. proposed an animal model to investigate the transplanted fat viability with different fat processing technique. His result showed no significant differences in fat cell viability, as assessed by graft weight maintenance or histologic evaluations, were observed with regard to fat processing techniques (centrifugation versus washing with normal saline)18. Salinas, H et al. performed an in vivo study to compare different fat processing methods in fat grafting. His result showed that 91% of adipocyte fraction was obtained by centrifugation of lipoaspirate at 1200g, which was equivalent to mesh/gauze technique. The adipocyte fraction remains constant above 5000g 23. In our case, we used sieve and multiple-layer gauze filtration method for fat processing, which is similar to mesh/gauze technique described by Salinas. We think this is the easiest, simple and effective method for fat processing.

For the fat graft transfer, we believed that fat graft survival is strongly related to diameter of the transferred fat grafts and their contact surfaces to the recipient area. Carpaneda reported in his study that only 40% fat graft survival at 1.5±0.5mm peripheral to the graft margin. He concluded that diameter of the fat graft should be <3mm to achieve higher graft survival rates24. Coleman also emphasized that each fat parcel transfer should be <1/10ml per injection so that central necrosis of a fat graft can be minimized by avoiding over injection when each parcel is placed9. In our presented case, we applied the concept of MAFT and used MAFT-Gun for fat injection because it provides the function of delivering small diameter (<3mm) and volume of fat parcel during each injection, which can be adjusted by rotating the dial on the MAFT-Gun. Lin et al firstly introduced the concept of microautologous fat transplantation in 2007. Favorable outcomes were demonstrated with the application of MAFT and MAFT-Gun9,25. The MAFT-Gun device can be adjusted to precisely deliver 6 fat-parcel sizes (0.017ml, 0.011ml, 0.0083ml, 0.0067ml, 0.0056ml, 0.00420ml). When multiple small diameter and volume of fat parcels are injected to the recipient sites, their contact surfaces to the recipient beds are increased so that, fat graft survival rates increase. Another advantage of using MAFT-Gun for fat graft transfer is minimizing risk of having noduleation, fat necrosis and skin irregularities as seen in conventional fat grafts transfer using syringe injection with large fat parcel delivery. In our department, we’ve been using MAFT-Gun for most of the fat graft procedures and there are no MAFT-Gun related complications.

Many authors have mentioned the use of the ‘reverse liposuction’ and mapping technique for fat grafts injections, especially for breast augmentation. Reverse liposuction refers to a constant back and forth motion of injection cannula while the fat graft is being injected. In the mapping technique, radial markings are firstly drawn in the recipient areas to guide the direction of fat injection in a diffuse and even manner. The injection cannula is inserted and makes multiple tunnels, which corresponds to the markings that fan out radially. The fat is then injected upon axial withdrawal only10. We used both ‘reverse liposuction’ and ‘mapping’ techniques with the aid of MAFT-Gun for fat grafts injection in order to ensure an even and three-dimensional dispersion of small parcels of the transferred fat.

In the previous literature reports, liposuction for fat grafting was performed under general anesthesia. With the maturation of liposuction technique using tumescent solution, most of the fat grafts transfer can be performed under local anesthesia. The standard undiluted dosage of lidocaine is about 5mg/kg or
7mg/kg if epinephrine is added. However, the upper limit of lidocaine dosage using the tumescent technique can be up to 35 mg/kg, which is agreeable to most plastic surgeon that it can be safely used. As in our case, we successfully performed MAFT under local anesthesia using Hunstad’s formula without lidocaine overdose or any other complication. Our patient felt no major discomfort during and after liposuction. His downtime for returning to normal activity and work was short. He was hence willing to receive second session of MAFT because he perceived a lower risk of complications when compared with general anesthesia. The patient provided ad hoc opinions regarding the amount of fat graft injected intraoperatively.

The relatively low risk of anesthesia and painless liposuction allows both patient and surgeon to both feel comfortable during fat graft transfer procedures.

In the previous literatures proposed by Lin, he used MAFT on augmentation rhinoplasty, sunken eyelids and other facial rejuvenation. His results of subjective measure of patient satisfaction were favorable. We advocate the MAFT on chest wall augmentation, as in Poland’s syndrome. With this concept and technique, same approach can also be applied on breast augmentation and other parts of the body. Currently, there is still lack of objective validation of MAFT. More clinical study should be designed to evaluate fat retention and survival in the future using the concept of MAFT and MAFT-Gun.

Conclusions

MAFT can be one of the treatment modalities for Poland’s syndrome with various degrees of deformity. It has the advantages of adding volume and filling the contour defect. It can be performed under local anesthesia, used alone or in combination with other reconstructive strategies. It provides a significant aesthetic outcome with low morbidity.

Reference


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利用精微自體脂肪移植來治療波蘭症候群以增強移植體積的功效 —— 病例報告

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背 景：
波蘭症候群臨床表現為單側胸大肌和手部異常（指畸形）及發育不全。患者手術的適應症是根據波蘭症候群是否造成功能和美學上的問題，患者的年齡和性別也必需列入手術決定因素。

目 的：
我們提出一個患有波蘭症候群的病患利用精微自體脂肪移植（MAFT）的手術治療方式。過去的文獻大多利用傳統的自體脂肪移植的方式，很少利用這種技術來應用於波蘭症候群的病患增加胸部的體積。因此在這文章介紹一個案使用 MAFT 技術來增大胸壁的體積。

方 法：
利用精微自體脂肪移植（MAFT）來治療一位 60 歲患有輕度波蘭症候群的男性病患，目的為了改善他胸壁凹陷以及不平整的外觀。我們利用一種叫 MAFT-Gun 的脂肪注射槍來進行脂肪移植。

結 果：
在兩次的脂肪移植手術後，病患左側胸部的凹陷明顯改善，雙側胸部很起來很對稱。並沒有發生手術相關或脂肪供應區的併發症。病患對於胸部的外觀及輪廓的改善覺得很滿意。

結 論：
精微自體脂肪注射可以用來治療不同程度的波蘭症候群。它可以在局部麻醉下進行，也可以單獨施行，或者跟其他治療波蘭症候群的手術方式併用。它可以達到很好的美學改善，而又不產生很高的併發症。