SKIN PADDLE AND DONOR SITE MORBIDITY OF MYOCUTANEOUS LATISSIMUS DORSI FREE FLAP FOR RECONSTRUCTION OF LARGE DEFECT

BY

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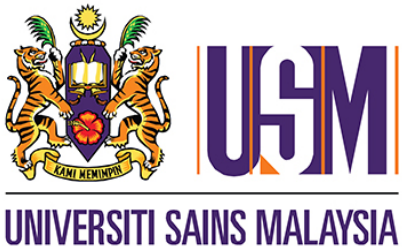

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IV ABBREVIATIONS

- MCLD	Myocutaneous Latissimus Dorsi
- SSG	Split Thickness Skin Graft
-WD	Wound Debridement
-SA	Serratus Anterior
-DM	Diabetes Mellitus
-HPT	Hypertension
-ALT	Anterolateral Thigh
-LD	Latissimus Dorsi
-LDF	Laser Doppler Flowmetry

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VII ABSTRAK

‘Myocutaneous Latisimus Dorsi (MCLD) Free Flap’ ialah pembedahan rekonstruktif yang telah digunakan secara meluas kerana ia merupakan pembedahan yang tidak sulit dan mempunyai kesan minimal kepada bahagian penderma. Kesan mengambil tisu kulit ‘MCLD Free Flap’ dikaji dengan menganalisis komplikasi kepada bahagian penderma dan tisu kulit di kalangayang telah menjalani pembedahan yang melibatkan pelbagai bahagian tubuh.

Satu kajian retrospektif untuk semua pesakit yang menjalani pembedahan MCLD free flap antara tahun 2000 sehingga 2012 dilakukan. Data demografi, butiran pembedahan dan komplikasi telah diperiksa. Soal selidik QuickDASH dilakukan untuk pesakit yang masih di bawah susulan dan dengan melakukan wawancara telefon untuk menilai fungsi bahagian bahu dan lengan .

Sebanyak 86 kes telah dikaji (27 wanita dan 59 lelaki) dengan purata umur 32 tahun (5 tahun hingga 69 tahun) . Pembedahan MCLD paling kerap dijalankan kerana ketumbuhan malignan (48.8 %) dan trauma (38.4 %) . Pembedahan yang paling kerap menggunakan MCLD adalah bahagian peha dan kaki. Purata lebar tisu kulit adalah 8.01 cm (4cm hingga 14 cm) dan min saiz dayung kulit adalah 206.1cm2 (45cm2 sehingga 440 cm2) .

Komplikasi bahagian penderma berjumlah 18% kes. Ini termasuk luka rekahan, ‘seroma’ dan kulit yang melepuh. Tiada faktor yang dapat dikesan berkenaan dengan komplikasi penderma. Komplikasi bahagian penerima berlaku sebanyak 48% kes. Faktor-faktor yang mempunyai kaitan penting dengan komplikasi bahagian penerima adalah pembedahan eksplorasi(p=0.01), kecederaan vascular(p=0.01) dan masa pembedahan yang panjang(p=0.02). Tiada hubungan yang signifikan antara MCLD free flap dengan keadaan fungsi bahu yang terjejas.

Kesimpulan dari kajian ini, di dalam pembedahan rekonstruksi menggunakan’ MCLD Free Flap’, saiz dan kelebaran tisu kulit tiada kaitan dengan kadar komplikasi di bahagian penderma mahupun bahagian penerima. Namun, terdapat hubungan yang signifikan antara kehadiran kecederaan vaskular, masa pembedahan panjang dan pembedahan eksplorasi dengan komplikasi bahagian penerima.

VIII ABSTRACT

Myocutaneous Latissimus Dorsi (MCLD) Free Flap has been widely used for reconstructive purpose as it reliable, fairly easy to perform and is believed to have minimal donor site morbidity. We aim to study the effect of raising large skin paddle of MCLD free flap by analyzing the complication of donor and recipient site. Other factors that might affect the complication were also studied.

A retrospective study of all consecutive patients operated between 2000 until 2012 that required MCLD free flap was performed. Demographic data, operative details and complications were examined. The *Quick*DASH questionnaire was performed in patient who was still under follow up and by doing telephone interview to assess the upper limb function.

A total of 86 cases were studied (27 women and 59 men) with average age of 32 years old (5 years to 69 years). The most common aetiology for reconstruction was malignancy (48.8%) and trauma (38.4%). The MCLD free flap was mostly used for reconstruction of lower extremity. The mean skin paddle width was 8.01 cm (4cm to 14 cm) and the mean skin paddle size was 206.1cm^2 (45cm^2 to 440 cm^2).

Donor complications occurred in 18% cases which include wound breakdown, seroma and blisters formation. There was no significant factor that was found to have association with the development of donor complication. Recipient complication occurs in 48% of cases. Factors that have significant association with development of recipient

complication were flap re-exploration (p=0.01), presence of vascular injury (p= 0.01) and long operative time (p=0.02). A total of 22 patients answered the *Quick*Dash questionnaire. There were no significant different between size of skin paddle with limitation of shoulder function.

In conclusion, reconstruction of large defect with Myocutaneous Latissimus Dorsi Free flap, the size and width of skin paddle has no significant association with donor or recipient complications. However, there were significant association between presence of vascular injury, long operative time and flap re-exploration with development of recipient complication.

INTRODUCTION

AND

LITERATURE REVIEW

1.0 INTRODUCTION AND LITERATURE REVIEW

1.1 Research background

History of reconstruction originated in India in 1440 AD where nasal defect was resurfaced with forehead flap. Later, evolution of flap progresses in phases with the early phases occurred during the First and Second World War where pedicled skin flap was used extensively. Then, during the 1950s to 1970s, the flaps evolve to axial pattern flaps with muscle and musculocutaneous flaps being transferred, and also introduction of free tissue transfer. In 1980s, the fasciocutaneous, osseous and specialized free flaps was introduced. The evolution in part occurs as a result of increasing severity and complexity of the defect as a result of war injuries and high impact collision with increased in the survival of the victims but also because of advances in microsurgery equipment and increasing expertise and experience in microsurgery(Strauch *et al.*, 2009; Wei and Mardini, 2009).

In reconstruction of large defect, free flap provide multiple type of tissue with different dimension to fulfill the requirement of reconstruction. However, free flap reconstruction need special expertise and extensive resources to be successful, thus measures should be taken to reduce the morbidity to the donor and patient, to ensure the best successful outcome.

Definition of large defect is arbitrary and site specific. A small full thickness wound in critical aesthetic area are considered as large defect in relative to the site of the organ in question. Myers and Ahn in their study compared the effect of size of free flap to the clinical outcome of patient

with cancers of head and neck. In their study of 121 patients, they found that very large area flap did not negatively affect clinical outcome of the patients. They arbitrarily defined large defect as 100cm^2 to 199cm^2 and very large defect as more than 200cm^2 (Myers and Ahn, 2014).

1.2 Myocutaneous Latissimus Dorsi (MCLD)Free Flap

The Latissimus dorsi flap was initially introduced by Tansini in 1906 for the coverage of extensive mastectomy defects. Olivari in 1976 described its use for the coverage of large radiation ulcers of the chest wall and later, Boswick in 1978 used the flap for breast reconstruction (Wei and Mardini, 2009).

The Myocuteanous Latissimus Dorsi (MCLD) free flap is a work horse in reconstruction because of its proven versatility and reliability. The advantages of this flap include its well known and predictable vascular anatomy, long vascular pedicle and large diameter vessel. Besides that, large amount of skin and muscle can be harvested with minimal donor site morbidity. The flap can also be raised together with serratus anterior muscle and scapula as combined flap (Kosutic *et al.*, 2008; L'Heureux-Lebeau *et al.*, 2013).

As a pedicle myocutaneous flap, it is known for reconstruction of head and neck, chest, breast and upper arm (Har-El *et al.*, 1999; Micali and Carramaschi, 2001; Chang *et al.*, 2002). When used as free myocutaneous flap it virtually can be used for various area of the body for many indications such as full thickness defect of the abdominal wall (Kadoch *et al.*, 2010), anterior

skull base defect post oncological resection (Girod *et al.*, 2012), upper and lower limb soft tissue defect and also total phalloplasty (Djordjevic *et al.*, 2006).

When used for reconstruction of large defect, the limiting factor for Myocutaneous Latissimus Dorsi (MCLD) free flap is the relatively small skin paddle that can be harvested so that the donor site can be closed primarily. Skin graft is needed to cover the Latissimus dorsi muscle when the skin defect is wider than the skin paddle available. To increase the width of skin paddle, a number of authors had designed their skin paddle into multiple sliding shaped. By doing this, albeit the small amount of patient these authors successfully raised a larger skin paddle of which can be use to close their recipient site primarily without usage of SSG and without compromising the donor site closure. This include the sliding –shaped flap by Sawaizumi and Maruyama, dividing the skin paddle based on the descending and transverse branch by Miyamoto et al and multiple lobed flap by Zhang et al (Sawaizumi and Maruyama, 1997; Miyamoto *et al.*, 2013; Zhang *et al.*, 2013).

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1.3 The Latissimus Dorsi Muscle

1.3.1 Anatomy and Function

Latissimus dorsi is a broad muscle is located at the dorsal part of the body. It originated from the seventh and lower thoracic vertebrae spine, the lumbar and sacral spine processes, the posterior and middle outer rim of the iliac crest and also the tip of the scapula. The muscle interdigitated with fibers of the serratus anterior muscles and the intercostals muscles, it converges into a flat, broad tendon and inserts into lesser tubercle of the intertubercular groove of the humerus.

The Latissimus dorsi muscle functions are to medially rotate and adduct the humerus, for shoulder extension, depressing of the raised arm, and downward rotation of the scapula. These functions of the latissimus are synergistic with 6 other muscles of the shoulder girdle namely pectoralis major, teres major and teres minor, subscapularis, deltoid and coracobrachialis (Laitung and Peck, 1985).

1.3.2 Blood Supply

The Latissimus dorsi muscle has 2 dominant blood supplies, the thoracodorsal artery and the intercostal and lumbar perforators. The subscapular artery arises as a branch of the third portion of the axillary artery. Usually the circumflex scapular artery is the first branch of the subscapular artery and the second major branch of the subscapular artery is the thoracodorsal artery.

The thoracodorsal artery runs along the anterior border of the Latissimus dorsi muscle and then it enters the muscle from underneath, later it spreads into two or three major branches at the under surface of the muscle. The thoracodorsal artery bifurcates into a horizontal (medial or transverse) branch and a descending (lateral or vertical) branch. Within the muscle both branches divide into lesser branches which run medially and anastomosis with perforators from intercostals and lumbar arteries. The thoracodorsal artery supplies predominantly the Latissimus dorsi muscle but also gives branches to the serratus anterior muscle, the axillary skin, the subscapular and teres major muscles.

The minor blood supply to the Latissimus dorsi muscle come from perforators from the posterior intercostals arteries and lumbar arteries. They are found in two rows as segmental vessels 5–10 cm from the dorsal midline. The lateral row derives its blood supply from branches of the 9^{th}, 10^{th} and 11^{th} posterior intercostal artery and the medial row derives its blood supply from the 1^{st} and 2^{nd} lumbar artery (Wei and Mardini, 2009; Watanabe *et al.*, 2010).

Venous drainage of the flap is from the accompanying veins that follow the arteries. The primary drainage is from the thoracodorsal vein and the secondary venous drainage is from the concomitant veins which run with the perforating arterial vessels.

1.4 Donor Complication in Myocutaneous Latissimus Dorsi Free Flap

The donor site complication in Myocutaneous Latissimus dorsi flap had been reported in many previous studies. The common complication includes seroma, dorsal hematoma, limitation in the

shoulder movement and wound breakdown. There are also rare complications such as pneumothorax (Gandamihardja *et al.,* 2013) and lumbar hernias (Mickel *et al.*; Obregón *et al.,* 2013).

1.4.1 Seroma

Donor site seroma is the most common complication following harvest of Latissimus dorsi muscle. It was reported to occur as high as from 21% to 79% (Delay *et al.,* 1998). A seroma is a tumour like mass or swelling caused by localized accumulation of serum or fluid within a tissue or organ (Hurwitz *et al.,* 2014). Seroma occurs due to many causes such as the disruption of the lymphatic and vascular channels, the presence of dead space, the shearing of subcutaneous tissue between the underlying wound surfaces, and the release of inflammatory mediators (Harper *et al.,* 2012a).

There are numerous patient and procedure-related factors have been shown to increase the incidence of seroma formation. Surgical procedures that created significant dead space volume or high-volume adipose tissue removal have been associated with an increased rate of seroma formation (Hurwitz *et al.,* 2014). Patient related risk factors include advanced age, obesity, associated co-morbidities such as advanced malignancy, malnutrition, liver failure, renal failure and congestive heart failure (Kuroi *et al.,* 2006; Sajid *et al.,* 2011). There are also other new risk factor which had been postulated to causes increases seroma formation such as preoperative use of selective serotonin reuptake inhibitors and calcium imbalance (Gruber *et al.,* 2011).

There are many potential problems when seroma occurs such as causing discomfort and poor cosmesis. Furthermore, in flap surgery if a large seroma causing an undue tension on the overlying flap tissue ischemia and necrosis may ensue. Besides that, after simple drainage of seroma it have high recurrence rate. This is likely due to the formation of a bursa sac or encapsulation that prevented apposition of the walls of the seroma hence making the seroma more prone to recurrence. This management is labour intensive often involving repeated drainage and compression drainage to prevent re-accumulation. Lastly, seroma can become secondarily infected requiring surgical drainage (Hurwitz *et al.*, 2014; Miranda *et al.*, 2014).

Because of this, numerous surgical techniques to reduce seroma rates at the donor site are described in the literature such as drain insertion, quilting sutures and fibrin glue (Sajid *et al.*, 2011; Cheng *et al.*, 2014; Miranda *et al.*, 2014). Miranda et al. investigate the usage of drains in latissimus dorsi in breast reconstructive procedure. They compare the difference between patients' that had the removal of drain in day three regardless of output (early group) and the patients' that had removal of drain according to the volume drainage in 24 hours (late group). They found out that there were no differences in total complications, seroma, dehiscence or haematoma rates between both groups. Seroma sub-analysis also indicated no differences in number of seroma aspirations, duration of drainage (months) and mean total drainage (ml) prior to resolution. However, they noted that as a result of early drain removal, patients had shorter hospital stay; thus reducing Latissimus dorsi breast reconstruction inpatient costs (Miranda *et al.*, 2014).

Many studies have reported the use of quilting or progressive multilayered tension sutures (Chippendale technique) to eliminate dead space at the Latissimus dorsi donor-site with convincing evidence on its effectiveness in seroma prevention (Titley *et al.*, 1997; Rios *et al.*, 2003; Gisquet *et al.*, 2010). Sajid et al. carried a systemic review is to analyze studies published on the use quilting alone or in combination with fibrin glue to reduce the incidence of donor-site postoperative seroma formation after Latissimus dorsi flap breast reconstruction. They found that quilting of the Latissimus dorsi flap donor site is helpful in reducing the incidence of seroma formation, reducing seroma volume, and reducing total drained seroma volume. They also concluded that quilting does not appear to inhibit muscular movements and should function apart from already reported muscle and joint morbidities related to Latissimus dorsi flap reconstruction. Besides that, they also found that combined quilting and fibrin glue further enhances its effectiveness (Sajid *et al.*, 2011).

1.4.2 Dorsal Hematoma and Wound Breakdown

Clough et al. studied complication of patients with extended Latissimus dorsi procedure for breast reconstruction. In this study from 43 patients, only 8 patients (18.6%) have problems with skin slough and 1 (2.3%) patient experience dorsal hematoma (Clough *et al.*, 2002). In another study of extended Latissimus dorsi flap, Fatah et al reported of only 2 of their 118 cases develop marginal superficial skin necrosis of the donor site and they have only 1 patient with dorsal hematoma (Fatah, 1999).

Li et al. studied aspects of Latissimus dorsi free flap for coverage of head and neck cancer. In their 116 patients only 7 patients suffered wound dehiscence. All of these cases involved large skin paddles and wounds that were closed under tight tension. Each of these cases required prolonged wound management and ultimately skin grafting. Subsequently, in similar cases they closed the donor with split thickness skin grafts at the time of flap harvest, 10 of the donor sites subsequently were closed using split thickness skin graft. They concluded that, donor complications depended on whether the donor wound was closed primarily or treated with a split-thickness skin graft. However, the complication that occur with SSG was not mentioned (Li *et al.*, 2012).

1.4.3 Limitation in Shoulder Movement

There are many studies that examine the biomechanical and functional changes that result from removing the Latissimus dorsi muscle from the shoulder unit. Many reports described the use of the Latissimus dorsi muscle stated subjectively that shoulder function was unchanged such as the study by Laitung and Peck, they objectively measure shoulder adduction in 19 patients in which the Latissimus dorsi muscle was removed and used as a free flap. With arms at 90 degrees of abduction, they utilized a Salter spring balance to examine adduction strength. They determined that adduction strength was not affected; however scar contracture and loss of range of motion occurred. They concluded that Latissimus dorsi muscle transfer did not affect arm adduction strength, and that therefore shoulder function was not affected (Laitung and Peck, 1985).

Another study by Brumback et al. also concluded that there is no loss of range of motion or interference with daily activities except for when the arms are held in 60 degrees of flexion, the forced extension is weaker than controls. In this study, they examined the dominant and non dominant shoulders of 17 patients and were compared with 17 healthy volunteers. The patients were examined 22 to 96 months post free muscle transfer. Patients were questioned regarding daily activities and were evaluated for scar quality, range of motion, and different isometric, isotonic, and iso-kinetic strength tests. They reported that none of the patients noted any change in the ability to perform activities of daily living or had to modify sports-related activities because of shoulder function. Passive range of motion was not reduced in these patients (Brumback *et al.*, 1992).

A more recent prospective study by de Oliveira et al. found that in breast reconstruction with a Latissimus dorsi flap there is no increased in the restriction of shoulder function, despite the anatomical manipulation of muscles important for arm mobility that is inherent in the Latissimus dorsi flap procedure. In this study they compare patients that undergone mastectomy alone with mastectomy and reconstruction with pedicled Latissimus dorsi and they noted that there is absence of any significant association between the latissimus dorsi flap procedure and important postsurgical ailments such as pain, reduced shoulder strength, and increased sensation of arm weight (de Oliveira *et al.*, 2013).

However, some studies did show negative effect in function when the Latissimus dorsi muscle is removed. In 1995, Fraulin et al. studied the change in muscle power and endurance in which they

evaluated 10 men and 16 women, 1.2 to 7.7 years after pedicled (women) or free (men) Latissimus dorsi transfer against 15 controls (six men, nine women). Fifteen of the 26 patients reported difficulty with at least 1 activity since surgery. But only 4 complained of greater than 10 activities in which they had difficulty since surgery. Most of these activities involved working with the arm above the head. The authors concluded that women who underwent a unilateral pedicled Latissimus dorsi transfer showed a deficit of power and endurance in shoulder extension and adduction as well as three work-simulated activities: ladder climbing, overhead painting, and pushing up from a chair. However, men who had previously undergone a free vascularised Latissimus dorsi transfer showed a deficit in power and endurance in shoulder extension and adduction but no work-simulated activities (Fraulin *et al.*, 1995).

Fraulin et al. studied the biomechanics of the shoulder function after Latissimus dorsi muscle transfer and they came into two conclusions, the first is that there are definite biomechanical changes that occur in the shoulder girdle following Latissimus dorsi muscle transfer. It is noticed by the patient by more rapid onset of fatigue during prolonged activities such as swimming, ladder climbing, overhead painting, or pushing up from a chair. However, over time any functional deficit will lessen, and normal function should be regained. Secondly, range of motion of both active and passive, are unchanged following removal of Latissimus dorsi muscle removal (Fraulin *et al.*, 1995).

1.5 Quantification of the Disability of the Arm and Shoulder functions using *Quick*DASH

Upper limb function is vital for performance of activities of daily living and specific work or sport related activities. The DASH is a patient self-rated questionnaire that is specific for upper extremity. It was introduced in 2001 by the American Academy of Orthopaedic Surgeons to measure disability caused by various upper limb disorders and the validity and reliability of the DASH has been demonstrated in the general population (Beaton *et al.*, 2001).

A shorter version, *Quick*DASH was developed to reduce the administration issues and increase user compliance by Beaton et al. (Beaton *et al.*, 2005). The *Quick*DASH consists of 11 items from the original DASH concerning the patient's health status during the preceding week. Each item has five response scores and the scores for all items are used to calculate a scale score ranging from 0 (no disability) to 100 (most severe disability). Gummesson et al. have shown that the *Quick*DASH can be interchanged with DASH without loss of precision and they also demonstrated the ability of the shortened instrument to detect changes in upper limb function, or measurement of response to treatment (Gummesson *et al.*, 2006).

The Malay *Quick*DASH which was translated by Dr. A. Al-Husuny, A/P Dr. A. Manohar and Prof. Dr. L. Rampal from the Faculty of Medicine and Health Sciences, University of Putra Malaysia was used for this study.

OBJECTIVES

OF

STUDY

2.0 OBJECTIVES OF STUDY

The objective is to determine the dimension of skin paddle for Myocutaneous Latissimus Dorsi (MCLD) free flap that was closed primary without adverse effect to the donor site and the survival of the flap.

2.1 General

To evaluate the morbidity of skin paddle and donor of Myocutaneous Latissimus Dorsi (MCLD) free flap used for reconstruction of major defect

2.2 Specific

1. To determine the skin paddle size harvested which was closed primarily
2. To determine the survival of skin paddle and progression of skin paddle necrosis
3. To assess morbidity of recipient site
4. To assess the donor site morbidity in relation to size of skin paddle by assessing wound breakdown and seroma formation
5. To assess the donor site shoulder function using *Quick*DASH questionnaire.

2.3 Research Hypothesis

In reconstructions of large defects with Myocutaneous Latissimus Dorsi (MCLD) free flap, the skin paddle size can be more than 8cm (4cm until 11 cm) in width without causing significant morbidity to the donor site with 100% survival rate of the skin paddle.

2.4 Null Hypothesis

There is no mean difference in the skin paddle size between patient with and without wound breakdown and functional deficit.

MATERIAL

AND

METHODS

3.0 MATERIAL AND METHODS

3.1 Ethical Approval

This study was conducted in Hospital Universiti Sains Malaysia. This study was approved by the Medical Ethics Committee of the School of Medical Sciences, Universiti Sains Malaysia (FWA Reg. No:00007718; IRB Reg. No; 00004494) on 5th June 2014. Relevant data was kept confidential and only to be used for this study.

3.2 Design of Study

This is a retrospective study involving 86 consecutive patients who underwent reconstruction with Myocutaneous Latissimus Dorsi (MCLD) Free Flap in Burn and Reconstructive Sciences Unit at Hospital Universiti Sains Malaysia from year 2000 until 2012 for coverage of large defect. Large area flaps are defined as skin paddle size of more than 200cm^2.

3.3 Sample Size

All consecutive cases of Myocutaneous Latissimus Dorsi Free Flap during study period of twelve years from 2000 until 2012 were included. The operative record book was studied and all patients that had key word of Latissimus dorsi flap operation were included. A total of 104 patients were included. Patients that were confirmed to have pedicle Latissimus dorsi flap reconstruction were excluded. Incomplete record either due to lost of the medical file or

incomplete record or lost data were also excluded. Total number of patient finally included in the study was 86 patients.

3.4 Subjects

This is a retrospective study involving 86 consecutive patients that require reconstruction with Free Myocutaneous Latissimus Dorsi flap in Burn and Reconstructive Sciences Unit at Hospital Universiti Sains Malaysia from year 2000 until 2012.

Patient's records and the photographs were analyzed for demographic data and also evidence of complication of the surgery. Incomplete patient record data, lack of data recording and poor chronology of events, and aborted cases were excluded from the study.

The patients with follow up in Hospital Universiti Sains Malaysia were requested to answer a questionnaire QuickDASH or Malay QuickDASH (Appendix I & II) for assessment for their shoulder and arm function. Patients that had been lost to follow up will be called for review in the clinic. For patients who were unable to attend the clinic follow up, the questions was carried out over the phone.

3.4.1 Inclusion Criteria

- All patients who had undergone reconstruction of large defect with Myocutaneous Latissimus Dorsi (MCLD) Free Flap from 2000 until 2012.

3.4.2 Exclusion Criteria

- Patients with incomplete record and data.
- Patients with exciting disabilities that prevent assessment of the shoulder function. Example of such condition include brachial plexus injury and congenital deformity

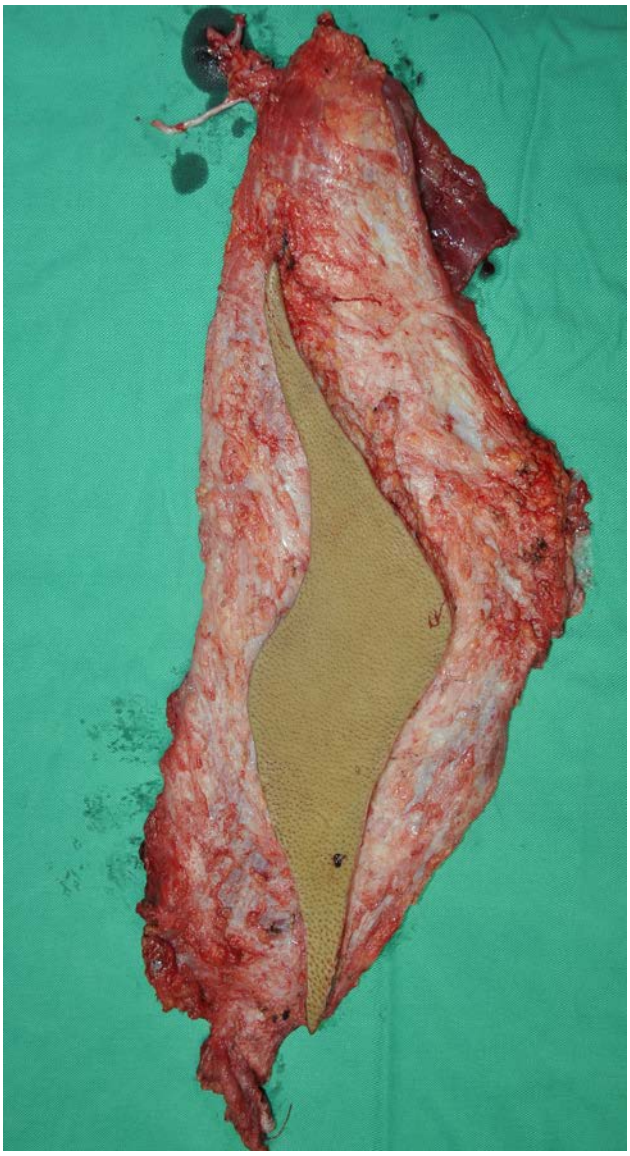
  .

3.5 Surgical Techniques

The MCLD is usually harvested from the ipsilateral side with the patient in the lateral position. After outlining the Latissimus dorsi muscle, a lazy-S shaped skin paddle is design near to the anterior edge of Latissimus dorsi muscle (Figure 1 and 2). The flap is harvested in the usual manner. The flap is transferred to the defect and then inset to the fit defect. Vessels used for anastomosis and type of anastomosis performed (end to side, end to side or side to side) was chosen according to the best available vessels during the surgery and also with surgeons' preferences. All anastomosis was performed using microscope magnification using microsurgical suture size *9.0* and *10.0*. The donor site is closed primarily. Two large drains were inserted and the involved chest was strapped with Hypafix®.

Figure 1: The Lazy-S Design of MCLD Skin Paddle

Figure 2: The Lazy-S Design on Harvested MCLD Free Flap



3.6 Consent for the Study

Written informed consents were obtained from patients after counselling and understanding the information sheet given. Patient that was unable to come to clinic for follow-up, verbal consent was taken before phone interview. For patients below 18 years of age, consents were obtained from their guardian. The consent, in Bahasa Malaysia and English has been validated by the Biostatistics and Research Methodology Unit, Hospital Universiti Sains Malaysia (Appendix III & IV).

3.6 Statistical Analysis

The results obtained from the patients record is analyzed using the Statistical Package for Social Sciences (SPSS 21.0 for Windows) statistical package programme licenced for National Clinical Reserach Centre (NCRC). Independent t test was used to determine the effect of flap. The level of significance was $p < 0.05$. The association between size and width flaps with development of complications was tested using Chi-square test. P-value of less than 0.05 was taken as significant. Chi-square test or Fisher Exact test was used to determine the associations between individual categorical independent factor and the outcome. Non parametric test Mann Whitney was used when assumption of normality was not met.

3.7 Flow chart