THE ANATOMY STUDY OF NASOLABIAL FOLDS REGION BASED ON HIGH-FREQUENCY ULTRASOUND INVESTIGATION IN THAI SUBJECTS

SORACHANA THEA

MASTER OF SCIENCE

IN

DERMATOLOGY

SCHOOL OF ANTI-AGING AND REGENERATIVE MEDICINE

MAE FAH LUANG UNIVERSITY

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Thesis Title	The Anatomy Study of Nasolabial Folds Region Based on High-Frequency Ultrasound Investigation in Thai Subjects
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ABSTRACT

Objective: To study the variation of Nasolabial vessels in Nasolabial folds and to study the basic structure of the nasolabial area such as skin, subcutaneous, and SMAS by high-frequency ultrasound in Thai people.

Methods: An observational cross-section study, a one-time examination by high-frequency ultrasound on the group who has received filler and never received filler to specify the depth and position of arteries and the structure of nasolabial folds.

Results: There were slight differences in the skin thickness, Subcutaneous layer, and SMAS in the filler injection group (n=8) and no filler group (n=25), the skin thickness of the non-filler group is slightly thicker than filler group, however the age, weight and the duration of the filler injection may affect the results. Moreover, there was a variation in the artery position in points A, B, and C of NLF in the same Thai population (n=33).

Conclusion: High-frequency ultrasound can visualize the basic structures of the Nasolabial folds region and can identify the position and the depth of the Facial artery in the NLF region.

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ABBREVIATIONS AND SYMBOLS

NLF   Nasolabial fold

mm   Millimetre

WSRS   Wrinkle severity rate score

RN1   Right nasolabial point A

RN2   Right nasolabial point B

RN3   Right nasolabial point C

LN1   Left nasolabial point A

LN2   Left nasolabial point B

LN3   Left nasolabial point C

HA   Hyaluronic acid filler

FA   Facial artery

CHAPTER 1

INTRODUCTION

1.1 Background and Rationale

Facial aging is an intricate process involving interrelated changes to bone, muscle, fat, and skin (Swift et al., 2020). It is typified by skin tone and texture deterioration, deflation due to loss of bone and fat, descent of soft tissues due to loss of muscle tone and skin elasticity, and disproportion occurring in different facial areas at different rates and chronological times. These changes can lead to deleterious emotional, psychological, and social effects because they alter self-perception and may affect the interpersonal relations of an individual (Swift et al., 2020).

One of the regions on an aging face that people notice is the nasolabial folds. The exact causes of this include alterations in the bone of the orbital rim, bone reabsorption at the canine fossa, weakened malar and orbital ligaments, the descent of the subcutaneous malar fat pad of the cheeks with hypertrophy of the nasolabial fat compartments leading to a loss of midface volume and a deepening of the nasolabial folds (Swift et al., 2020).

Soft-tissue filler is the most popular procedure for re-volumization mid-face and nasolabial correction. However, the nasolabial area is also known as one of the hazard zones for fillers or any other surgery due to the facial artery and its anastomosis. This procedure has several drawbacks and consequences, including oedema, erythema, lump formation, filler materials migration (Stefura et al., 2021), etc. Having thorough anatomic knowledge does not shield the expert from the possibility of creating an undesirable outcome It is quite hazardous and may lead to blindness caused by skin necrosis and vascular occlusion. By understanding the precise depth and position of the artery within this area is crucial for performing safe and effective procedures, including plastic and reconstructive surgeries, and aesthetic procedures like dermal filler

injections. This region's unique anatomy and vascularity make it a focus of interest for both clinical and research purposes.

The Angular artery is a terminal branch of the facial artery. It ends at the medial canthus region and branches to the medial side of the eyelid and the nose. This artery sometimes branches from the ophthalmic branch rather than the facial artery. In 51 % of cases, it is terminated from the branch of the facial artery (Kim et al., 2016). Traditional methods of artery visualization, such as Doppler ultrasound, have provided valuable insights into arterial anatomy. However, these techniques often fall short of providing precise depth and position information, which is necessary for minimally invasive procedures.

Ultrasound imaging technology has made significant advancements in recent years, enabling detailed visualization of anatomical structures in real-time. High-frequency ultrasound, in particular, offers the potential to accurately determine the depth and position of arteries in the nasolabial region. This has immense clinical significance, as it can guide the administration of injectables such as botulinum toxin injection in masseter muscles, pre- and post-procedure of filler injection (Lee et al., 2020) and used to treat vascular complications, aid in surgical planning, and enhance the overall safety and efficacy of procedures.

Several studies have employed high-frequency ultrasound to explore the feasibility of visualizing the facial artery in the nasolabial area. For instance, the study by Lee et al. (2020), successfully used ultrasound to determine the anatomical depth of facial artery in patients undergoing dermal filler injections, noting its potential clinical applications.

While these studies provide valuable insights, there is a need for a comprehensive investigation focusing on the variable of artery and the nasolabial structures within the nasolabial region. This research aims to fill this gap by utilizing advanced ultrasound imaging techniques to provide a detailed understanding of the artery's position, depth, and the basic nasolabial fold structures variations in Thai population groups. The findings of this study can serve as a foundation for enhancing patient safety and optimizing aesthetic and dermatologic procedures in the nasolabial region. Furthermore, the outcomes of this research could contribute to learning new

facts and educational resources for medical practitioners, making ultrasound a valuable tool for practice in the nasolabial area.

1.2 Research Questions

What are the variations of the artery at specific points and the nasolabial structures in Thai people by using high-frequency ultrasound?

1.3 Research Objectives

The primary objective of the study is to employ high-frequency ultrasound technology to precisely determine the position and depth of the artery and the basic anatomy in the nasolabial area. To achieve this objective, the following specific aims will be pursued:

1.3.1 To study the variation of Nasolabial vessels in Nasolabial folds.

1.3.2 To study the basic structure of the nasolabial area such as skin, subcutaneous, and SMAS by high-frequency ultrasound in Thai people.

1.4 Significance of the Study

Understanding the depth and position of the artery in the nasolabial region has far-reaching implications in various medical aesthetic and surgical fields. This research offers several important contributions:

1.4.1 Enhanced Safety in Dermal Filler Injections: Precise information on the artery's location will guide practitioners during dermal filler injections, minimizing the risk of arterial puncture and related adverse events, such as tissue necrosis (Li et al., 2018) and blindness.

1.4.2 Educational Resources: The study's findings can contribute to the development of educational resources and guidelines for healthcare professionals,

ensuring that ultrasound becomes a standard tool for assessing the nasolabial area's vascular anatomy.

1.4.3 Clinical Practice and Research: This research has the potential to advance clinical practice for artery assessment in the nasolabial region. It also opens avenues for future research into arterial variations and their clinical implications.

1.5 Scope of Study

The study will be conducted in Thai population, Healthy individuals, aged between 25-50 years and those who never received dermal filler and have received filler will be enrolled in this study. Each volunteer will receive a one-time high-frequency ultrasound assessment. The high-frequency ultrasound (VENUE, GE health care, USA) will be used to visualize the artery of Nasolabial folds. Moreover, the thickness of the nasolabial structures will be measured at specific points in both groups at Mae Fah Luang University Hospital Bangkok. The volunteers were selected by following inclusion and exclusion criteria. Data collection and analysis will be conducted over periods of three months to ensure a comprehensive assessment of variations in artery position within the nasolabial region. Moreover, the study will employ a quantitative research design, utilizing high-frequency ultrasound technology for visualizing the artery and measuring the nasolabial structures. Data will be collected through non-invasive ultrasound scans. The study will primarily focus on the artery in the nasolabial region. Data will be analysed using statistical methods, including descriptive statistics (means, standard deviations) to examine variations in artery depth. The study's findings will be discussed in the context of their clinical implications, particularly in surgical and aesthetic procedures involving the nasolabial region. The study will acknowledge certain limitations.

1.6 Conceptual Frameworks

The Variations of study:

1.6.1 High-Frequency Ultrasound Technology: The use of advanced ultrasound technology to visualize and measure the angular artery.

1.6.2 Population Groups: Various categories of study participants, representing different ages, and genders.

1.6.3 Depth of angular Artery: The outcome variable that measures the artery's depth from the skin surface.

1.6.4 Position of angular Artery: The outcome variable that assesses the distance of the artery concerning specific anatomical landmarks.

1.6.5 The nasolabial fold structures: skin, subcutaneous tissue, SMAS.

High-frequency ultrasound
(VENUE GE Healthcare, 2.5-20 MHz)

- The transducer (hockey stick probe) is placed along the nasolabial line by focusing on three points.

The transducer produces sound waves, and the sound waves weaken, as they scatter and produce the digital image.

Visualized the Nasolabial fold anatomy.

- Measure the basic nasolabial fold structure at each point such as skin, subcutaneous, and SMAS.

- Record the variation of arteries each person on both side of NLF.

Figure 1.1 Conceptual Framework

In order to visualize the anatomy of Nasolabial folds, we will used high-frequency ultrasound, The hockey stick transducer L8-18i-Rs, footprint 11.1×34.8 mm, 2.5-16.8 MHz is placed along the Nasolabial line by focus on three points, point A is at the lateral of nose, point B the half-way between point A and C, point C is located 1-2 cm lateral to oral commissure. The transducer produces sound waves, and the sound waves weaken, as they scatter and produce the digital image. After we get the real-time image of vessels record the artery of each volunteer on both sides of the NLF with measure the basic nasolabial fold structure such as skin, subcutaneous, and SMAS layer in the group who never received filler and who have received filler.

1.7 Operational Definitions

1.7.1 Aging

Aging is defined as a steady loss of physiological integrity that results in functional deterioration. It is divided into two extrinsic aging and intrinsic aging. Intrinsic aging is a biologically predetermined phenomenon that transpires spontaneously and is influenced by the deteriorative impact of free radicals, hormone fluctuations, and the body's limited capacity to fully restore skin damage. Extrinsic aging, sometimes known as photoaging or environmental and lifestyle aging, encompasses factors beyond UV radiation, such as cigarette smoking, air pollution, food, and stress (Swift et al., 2020).

1.7.2 Nasolabial Folds

The two skin folds that run from each side of the nose to the corner of the mouth. It is a facial structure that supports the buccal fat pad and separates the cheeks from the upper lip.

1.7.3 The Artery of the Nasolabial Area

The angular artery is a small branch of the facial artery, a major blood vessel located in the face. This artery plays a significant role in the blood supply of the face and is associated with the anatomy of the eye and nose. The artery is interconnected

with other arteries of the face, forming anastomoses that ensure a redundant blood supply to the facial region.

1.7.4 Ultrasound

Ultrasound also called sonography or diagnostic medical sonography, is an imaging method that uses sound waves to produce images of structures within your body (like liver, gall bladder, uterus, subcutaneous tissue, vascular structure, etc.). The image can provide valuable information for diagnosing and directing treatment for a variety of diseases and conditions.

1.7.4.1 Ultrasound Imaging: High-frequency ultrasound technology will be used to visualize the nasolabial artery, providing real-time images for analysis.

1.7.4.2 High-Frequency Ultrasound Imaging: Conduct ultrasound scans on each participant's nasolabial region to visualize and measure the nasolabial artery.

1.7.4.3 Anatomical Landmarks: Identify and record specific anatomical landmarks for each scan, ensuring consistency in data collection.

1.7.5 Hypoechoic

Hypoechoic means the areas appear dark grey on ultrasound scans because they don't send back a lot of sound waves. For example: in solid masses of dense tissue, hyaluronic acid is hypoechoic.

1.7.5.1 Anechoic

Anechoic means no echoic and appears black on ultrasound.

1.7.5.2 Hyperechoic

The material exhibits a high degree of reflectivity and typically presents itself in a range of light grey tones, reminiscent of the appearance commonly observed in skeletal structures and fascia.

1.7.6 Transducer

A transducer or probe is an integral component of ultrasonic equipment responsible for generating sound waves. When engaging with biological tissue, a fraction of the sound waves undergo reflection and then travel to the processor, where they undergo conversion into digital images.

1.7.7 Power Doppler

Doppler ultrasonography is a diagnostic procedure that is non-invasive in nature. It is employed to approximate the blood flow within the blood arteries by using high-frequency sound waves that are reflected off the circulating red blood cells. Medical imaging techniques have the potential to aid in the diagnosis of several medical disorders, such as blood clots, impaired functionality of leg vein valves, and arterial occlusion, among others. The measurement of blood flow velocity can be approximated through the assessment of the frequency modulation, or pitch, of the blood signal.

1.7.8 Soft Tissue Filler

Soft tissue fillers, commonly referred to as dermal fillers or injectable fillers, are a non-surgical alternative utilized for the purpose of replenishing facial volume and augmenting cosmetic rejuvenation. Common areas for filler application include the regions of the cheekbones, marionette lines, nasolabial folds, and the jowl region. Fillers can also be employed to augment the lips and temples, rectify shallow wrinkles and creases, as well as enhance the contour of sunken scars.

1.7.9 Structure of Nasolabial Layers

1.7.9.1 Skin

1.7.9.2 Superficial fat pads

1.7.9.3 Muscle: Orbital portions of the orbicularis oculi muscle, zygomaticus muscles, risorius muscle, buccinator muscle, levator muscle of upper lip.

1.7.9.4 Bone

1.7.10 The Thickness of Each Layer

The measurement will be recorded in three points by using the nasolabial line and drawing the plane from the lateral of the nose to the 1-2cm laterally to the oral commissure. The first point is A at the lateral nasal, the third point is C on 1-2 cm from the corner of the mouth, and the second point B is halfway between points A and C.

1.7.10.1 Skin: the length from the skin surface to the subdermal layers.

1.7.10.2 Subcutaneous: the length from the subdermal layer to the supra-muscular layer.

1.7.10.3 SMAS: from the Skin surface to the SMAS layer.

1.7.11 Informed Consent
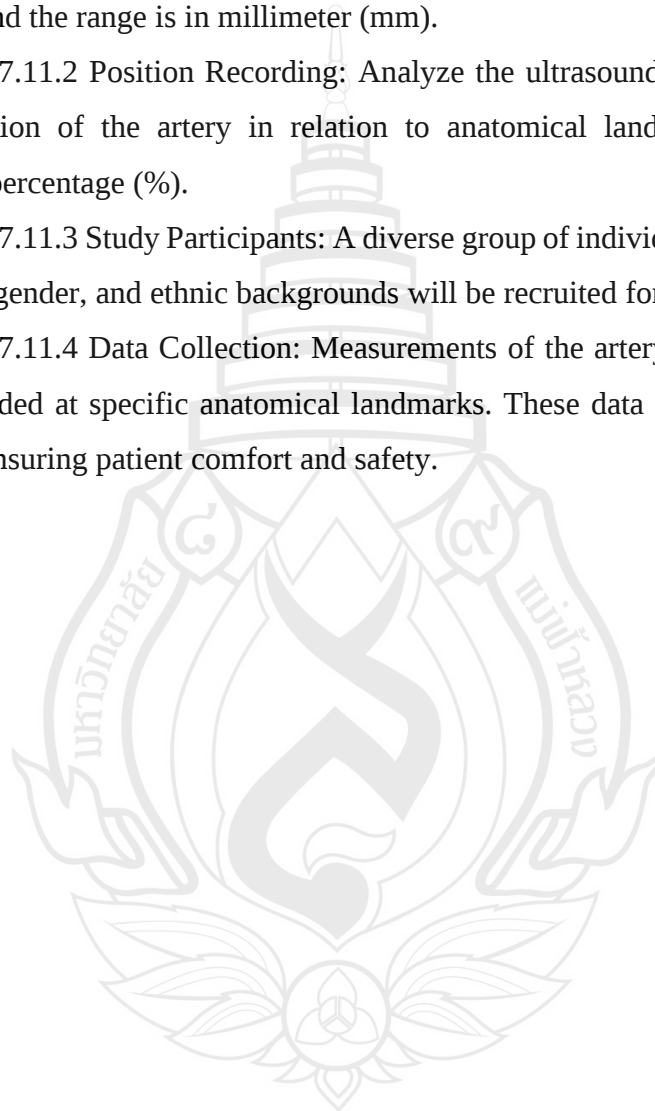
Obtain informed consent from study participants after explaining the study's purpose and procedures.

1.7.11.1 Measure Depth: Use the ultrasound data to measure the depth of the nasolabial artery from the skin's surface. Record these measurements for each participant and the range is in millimeter (mm).

1.7.11.2 Position Recording: Analyze the ultrasound images to assess the precise position of the artery in relation to anatomical landmarks. Record these positions in percentage (%).

1.7.11.3 Study Participants: A diverse group of individuals representative of various age, gender, and ethnic backgrounds will be recruited for this study.

1.7.11.4 Data Collection: Measurements of the artery's depth and position will be recorded at specific anatomical landmarks. These data will be obtained non-invasively, ensuring patient comfort and safety.

CHAPTER 2

LITERATURE REVIEW

The literature review presented in this chapter serves as the foundational framework for the current study, which aims to investigate the depth and position of the artery in the nasolabial region utilizing advanced ultrasound technology. Understanding the precise anatomical location and variations of the angular artery (terminal branch of facial artery) is of paramount importance in various clinical and surgical applications. This literature review is structured to provide a comprehensive overview of existing knowledge, the anatomical context, previous research on ultrasound imaging, and potential gaps in the field. By critically evaluating the extant literature, this thesis seeks to contribute valuable insights that can enhance patient safety, inform clinical practice, and guide future research endeavors in this specialized area of medical imaging and anatomical research. The items for the literature reviews of this study are as follows.

1. Introduction to Nasolabial region and its significance
2. Nasolabial correction
3. Dermal filler complications
4. Anatomy of the artery at Nasolabial area
5. Variation of artery among population
6. Clinical relevance of artery position
7. Traditional methods for assessing artery of face.
8. Advance in ultrasound imaging
9. Previous studies on ultrasound imaging
10. Related studies

2.1 Introduction to the Nasolabial Region and Its Significance

Nasolabial folds refer to prominent facial creases extending from the lateral aspect of the nose to the oral commissure, which arise due to a multifactorial interplay including the migration of midfacial adipose compartments, alterations in muscular topography, and dermal laxity. The folds originate laterally to the ala of the nose and end 1-2cm laterally to the oral commissure (Themes, 2020a). The deepening of the folds varies according to race, gender, age, and weight.

2.1.1 The Anatomical Layers of the Nasolabial Area Include the Following:

2.1.1.1 Skin

The epidermis, which is the outermost layer, is thin. Blood arteries, nerves, and other things like hair follicles are all found in the dermis layer, which is thicker.

2.1.1.2 Subcutaneous tissue

The subcutaneous layer is comprised of adipocytes and serves as both a thermal barrier and a source of stored energy. Furthermore, it serves the purpose of providing support and safeguarding the underlying structures.

2.1.1.3 Muscles

The movement and expression of the nasolabial area are facilitated by a number of muscles. The muscles include the levator labii superioris, zygomaticus major and minor, nasalis, and orbicularis oris (Figure 2.1).
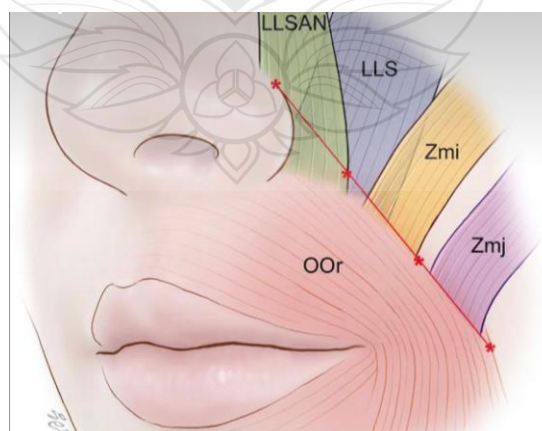
Figure 2.1 The Muscles That Related to the Nasolabial Folds

2.1.1.4 Facial ligaments and connective tissue

The ligamentous and connective tissue structures serve the purpose of securely attaching the skin to underlying anatomical components. The nasolabial ligament is an anatomical component that plays a crucial role in the maintenance of the nasolabial fold's posture.

2.1.1.5 Facial nerve branches

The facial nerve provides innervation to the muscles responsible for facial expression, especially those surrounding the nasolabial region. The motion of such muscles is regulated by the branches of the facial nerve.

2.1.2 Significance of Nasolabial Region

2.1.2.1 Facial expression

Changing muscular activity in the nasolabial region allows facial expressions like smiling, frowning, and other mouth-and-nose muscle movements.

2.1.2.2 Aesthetics and beauty

The nasolabial area affects facial attractiveness. Smooth, well-defined nasolabial folds are connected with a youthful appearance. Nasolabial changes like deepening folds with aging might affect appearance.

2.1.2.3 Age-related changes

The development of a more prominent nasolabial fold caused by reduction of skin elasticity, changes in muscle tone, and loss of fat. Cosmetic dermatology and plastic surgery often utilize dermal fillers to correct age-related changes.

2.1.2.4 Medical Significance

The nasolabial area has medical relevance beyond cosmetics. Certain medical disorders or symptoms may appear there. Nasal pain or tenderness may indicate sinusitis or dental difficulties.

2.1.2.5 Communication and social interaction

For efficient communication, the nasolabial region's motions and expressions are crucial. This area of the face can indicate a wide range of emotions and intentions, which can have an impact on interactions with others and relationships between individuals.

Nasolabial folds arise as a result of the contraction of the levator muscles of the lip during the act of smiling, leading to an increase in tissue expansion pressure inside the superficial nasolabial fat pad located above and Caucasian women have shown greater nasolabial fold severity than African American and Asian women ($P \leq 0.029$), and Caucasian men have shown significantly greater nasolabial fold severity than Asian men (Swift et al., 2020).

The clinical signs of nasolabial fold and aging include triangular depression, widening of the nasal nostril, elongation of the upper lip, and elongated nasolabial with dynamic and fine lines. In addition to this, skin thinning, and skin fibrosis are also noticed in that area. The folds usually form at the age of 30 or earlier, by the 40s the nasolabial fold becomes deeper, and by the 50s the nasolabial folds are increasingly prominent (Swift et al., 2020). The prevalence has been reported to be as high as 85% by age 40 to 49 years However, the process can be accelerated or anticipated by genetic variables, lifestyle choices, smoking, UV light, and severe ponderal changes.

2.1.3 The Causes of Deepening Nasolabial Creases

2.1.3.1 Bone

The facial bones offer stability, definition, and a framework for the attachment of surrounding soft tissue. As we age, the bones shrink and remodel, which causes the soft tissue that lies on top to recede and change position, relocating fat pads and muscle in the inferior and medial directions. The piriform and canine fossa recede, along with dento-alveolar regression and maxillary retrusion, all contribute to the deepening of nasolabial folds.

2.1.3.2 Fat

The nasolabial fat pad (i.e., the inferolateral section of what was previously termed the malar fat pad) may descend from loss of support as the maxilla and the mandible bone recede and/or lateral deep medial check fat atrophies (Swift et al., 2020). The weakening of the orbital and malar ligaments and stretching of the fascial septa in the nasolabial fat pads may make this fall worse by reducing the support they provide.

2.1.3.3 Muscle

The manifestation of facial muscle aging symptoms associated with senescence arises from the repetitive contraction of muscles and changes in muscle

tone. The act of smiling involves the elevation of the lip towards the nasolabial fold, which is facilitated by the levator muscle bundles that originate from this fold. They involve the levator muscle of the upper lip raising the lip and the fold upward. Paralysis of facial muscles effaces the nasolabial fold, conforming action of the mimic muscles and their influence on a deepening of the fold (Themes, 2020a).

2.1.3.4 Skin

The process of skin aging can be attributed to two primary causes, namely intrinsic factors, and external factors. The main extrinsic factors are photoaging from UV light followed by smoking and air pollution. The skin tends to develop coarse wrinkles, pigment, dryness, etc. The dermis layer consists of collagen, elastin, and glycosaminoglycans, which contribute to the maintenance of skin hydration. Intrinsic aging is characterized by the thinning and weakening of the skin, accompanied by dermal atrophy, collagen degradation, glycosaminoglycan degradation, and the subsequent development of wrinkles (Swift et al., 2020).

2.1.4 The Wrinkle Severity Rate Score (WSRS) of Nasolabial Folds

Table 2.1 The Wrinkle Severity Score

Grade	Severity
1	Absent: no visible NLFs; continuous skin line.
2	Mild; shallow but visible NLFs with a slight indentation.
3	Moderate; moderately deep NLFs; visible at normal appearance but not when stretched.
4	Severe; very long and deep NLFs; $< 2mm$ visible NLFs when stretched; prominent facial features.
5	Extreme; extremely deep and long NLFs; 2 to 4mm V-shaped folds when stretched; detrimental to facial appearance.

Source Qiao et al. (2019)

Source Dayan et al. (2019)
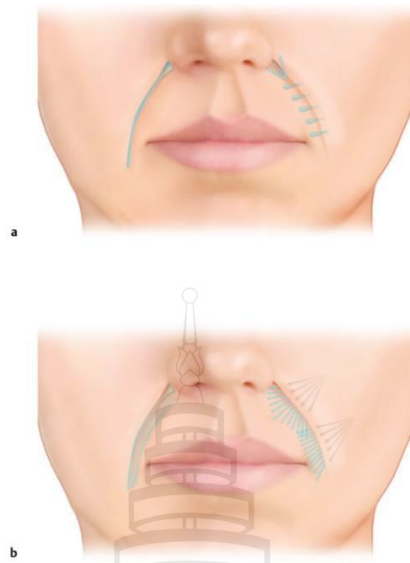
Figure 2.2 The Severity Score of Nasolabial Fold

2.2 Nasolabial Fold Correction

Recently, a number of nasolabial enhancement options have been available, including dermal filler (hyaluronic acid, polymethylmethacrylate, calcium hydroxyapatite), laser resurfacing, radiofrequency devices, fat grafting, HIFU, and thread lifting.

2.2.1 Dermal Filler

The cheek's descent and volumetric loss in the malar mound can cause the skin's lateral fold to fold over. The fold's medial section may descend due to the top lip and perioral complex becoming thinner. The implementation of product placement in this particular area can be achieved by several approaches such as cross-hatching, fanning, linear threading, or serial piercing methods (Kontis & Lacombe, 2013) (Figure 2.3). The placement of the substance typically varies in terms of depth, with deeper application for folds versus more shallow application for wrinkles.

Source Kontis and Lacombe (2013)

Figure 2.3 Techniques to Treat the Nasolabial Fold

Numerous items have received approval for utilization within this geographic area, encompassing hyaluronic acid (HA), calcium hydroxyapatite (CaHA), polymethylmethacrylate (PMMA), Polycaprolactone, and other such substances.

2.2.2 Laser Resurfacing

Erbium: YAG laser resurfacing and Co2 laser resurfacing have been used to minimize the wrinkles and fine lines. Both laser systems are "ablative" laser skin resurfacing techniques and they target mainly the epidermis but also affect the dermis (Derm.net).

2.2.3 Radiofrequency Devices

It is a non-invasive procedure that employs a device to transmit radiofrequency (RF) radiation into the skin's deeper layers. This heating action promotes an immediate tightening of the skin's tissue and structural elements.

2.2.4 Fat Grafting

A technique called "fat grafting" involves injecting extracted adipose tissue under the skin to aid in repair. Through the improvement of tone and texture, autologous fat grafting used for facial rejuvenation gives the face its lost volume. The bottom part of the face encompasses several prominent anatomical structures, such as the nasolabial fold, labio-mandibular fold, pre-jowl sulcus, lips, and chin. The nasolabial fold becomes more pronounced when the cheek loses volume, and addressing the malar fat compartments through filling can effectively elevate the nasolabial fold (Schultz et al., 2020)

2.2.5 HIFU

A non-invasive skin tightening treatment. Ultrasound waves turn into heat and cavitation, causing tissue injury and necrosis (Contini et al., 2023). The superficial muscular aponeurotic system (SMAS) layer and (deep) dermal layers are targeted. The mechanism of action of high intensity focus ultrasound including delivery of energy initiates the natural wound healing process, Fibroblasts create new collagen over time, healthier, reducing skin laxity, and tighter skin resulting in the lifting of tissue to a more youthful look. HIFU is utilized for skin rejuvenation, skin tightening, nasolabial fold reduction, jowl lifting, malar enlargement, and skin rejuvenation.

2.2.6 Thread Lifting

The thread lift process is widely recognized and regarded as a prominent and efficacious method for rectifying facial contour irregularities, as well as mitigating the appearance of deep wrinkles, even among individuals who have surpassed the age of 50. Indications of thread lift are sagging chin or cheeks, change in the facial contours due to the appearance of deep wrinkles in the nasolabial fold and around the eyes, and to elimination of submental fat and neck contouring.

2.3 Dermal Filler Complications

There are several studies that have been mentioned in prevention strategies regarding soft tissue filler injection. However, it is important to acknowledge that issues

may occur, necessitating the need for recognition. The potential hazards linked to dermal fillers depend on the filler used and the anatomical site of administration. The study by Witmanowski and Błochowiak (2020), can be divided the complications into non-ischemic and ischemic complications.

Non-ischemic complications are not specific to the type of dermal filler. The many consequences observed at the injection site include erythema, edema, itching, and bruising, which are frequently encountered. Other complications are persistent erythema, depigmentation, lumpiness, persistent granulomatous foreign body reaction, ulceration, contour irregularities, the Tyndall effect, infection or biofilm formation, ulceration, inflammatory reaction, and bluish discoloration.
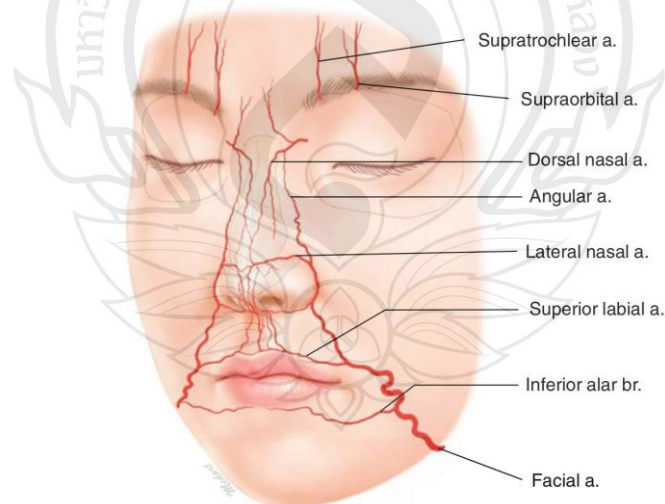
Ischemic complications are the most fearful and serious complication related to the use of dermal fillers leading to arterial or venous occlusion, followed by ischemia, with necrosis of skin or vision loss. One of two causes of necrosis is either a vascular supply disruption caused by compression, or a vessel obstruction marked on by a substance being injected directly into the vessel. The incidence of vascular occlusion has been reported as being up to 3 in 1000 injections and for HA injections the incidence of vascular occlusion may be slightly less at 3-9 per 10,000 injections (Witmanowski & Błochowiak, 2020).The most high-risk injection areas associated with visual compromise include the glabellae, forehead, nasal region, nasolabial folds, and temple due to artery supply and its anastomosis with the ophthalmic artery (Witmanowski & Błochowiak, 2020).

2.4 Anatomy of the Artery at Nasolabial Area

The blood vessels on the face are crucial. Blood vessel-related problems, including skin necrosis and blindness will be more noticeable as fillers become more widespread. The facial artery supplies the nasolabial fold areas. The facial artery follows its route in the nasolabial fold, where it divides into the inferior and superior labial branches, the septal branch, which irrigates the nasal septum, and the alar branch, which in turn supplies the ala of the nose. The facial artery divides into these two branches and then continues an ascending course, dividing into the lateral nasal branch

and forming anastomoses with the septa and alar branches, the dorsal nasal branch of the ophthalmic artery, and the infraorbital branch of the maxillary artery.

The facial artery splits off from the external carotid artery, courses the inferior border of the mandible, and curves upward to the lateral aspect at pre masseteric notch beneath the platysma. Located within the buccal space, there exists a tortuously rising structure with a diameter measuring roughly 2.14 mm (Isaac et al., 2023). The facial artery, which traverses the upper-medial region of the face, gives rise to the inferior labial artery, superior labial artery, and lateral nasal artery. It ultimately concludes its course as the angular artery (Figure 2.4). additionally, the study by Ten et al. (2020), in 84 cases about the evaluation of facial artery course variation and depth, found the facial artery courses may be highly superficial (2.5 mm at the mandibular origin, 3.7 mm at the cheilion, 3.7 mm at the nasal ala) or it may follow a very deep course near the periosteum (15.0 mm at the mandibular origin, 18.7 mm at the cheilion, 23.5 mm at the nasal ala). FA depth varied between 5.98 mm and 6.62 mm at the mandibular origin, between 8.36 mm and 9.20 mm at the cheilion, between 9.52 mm and 10.51 mm at the nasal ala (Ten et al., 2020).

Source Kim et al. (2024)

Figure 2.4 The Course of the Facial Artery

2.4.1 Facial Artery Branches

2.4.1.1 Superior, Inferior labial branch

The facial artery ascends obliquely to the angle of the mouth. The superior labial artery supplies the upper lip. And the inferior labial artery to the lower lip.

2.4.1.2 Inferior alar branch
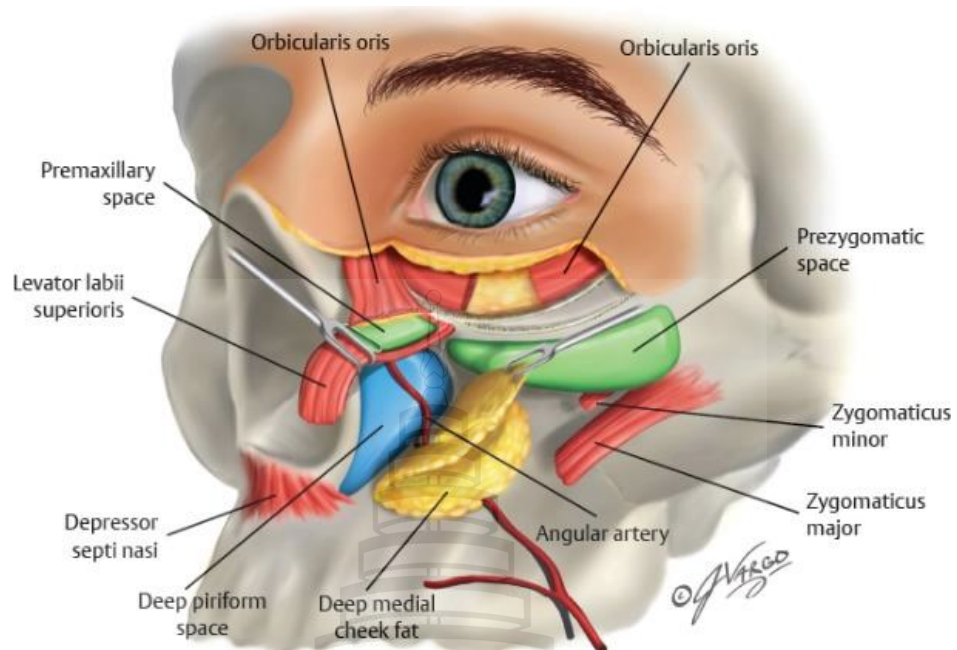
The inferior alar branch courses towards the columella in close proximity to the nasal ala. The artery in question combines with columellar branches originating from the superior labial artery, resulting in the formation of an arterial structure that extends to the nasal tip.

2.4.1.3 Lateral Nasal branch

The lateral branch supplies the ala and nasal bridge. Following the division of the lateral aspect adjacent to the nasal ala, the course of the anatomical structure extends down the lateral side of the nose, subsequently connecting with both the nasal branch of the infraorbital artery and the nasal branch of the ophthalmic artery.
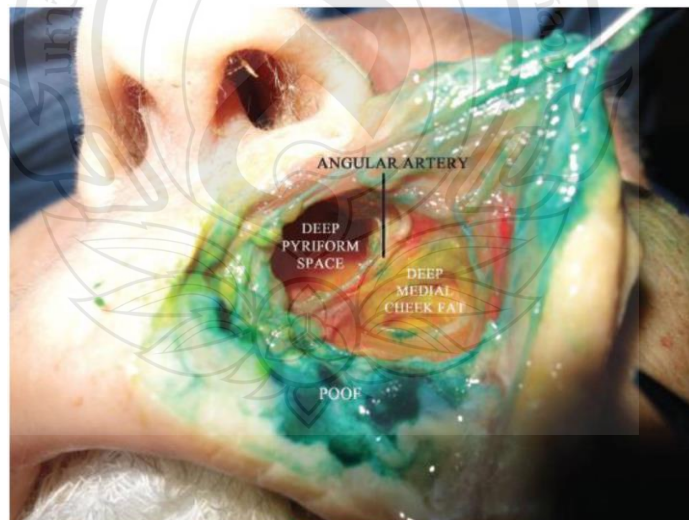
2.4.1.4 Angular artery

It is a terminal branch of the facial artery. It ends at the medial canthus region and branches to the medial side of the eyelid and the nose. This artery sometimes branches from the ophthalmic branch rather than the facial artery. In 51 % of cases, it is terminated from the branch of the facial artery (Kim et al., 2024). The angular artery courses between the space and the deep medial cheek fat compartment, not directly on the periosteum (Themes, 2020a) (Figures 2.5 and 2.6).

Figure 2.5 The Angular Artery and Piriform Fossa
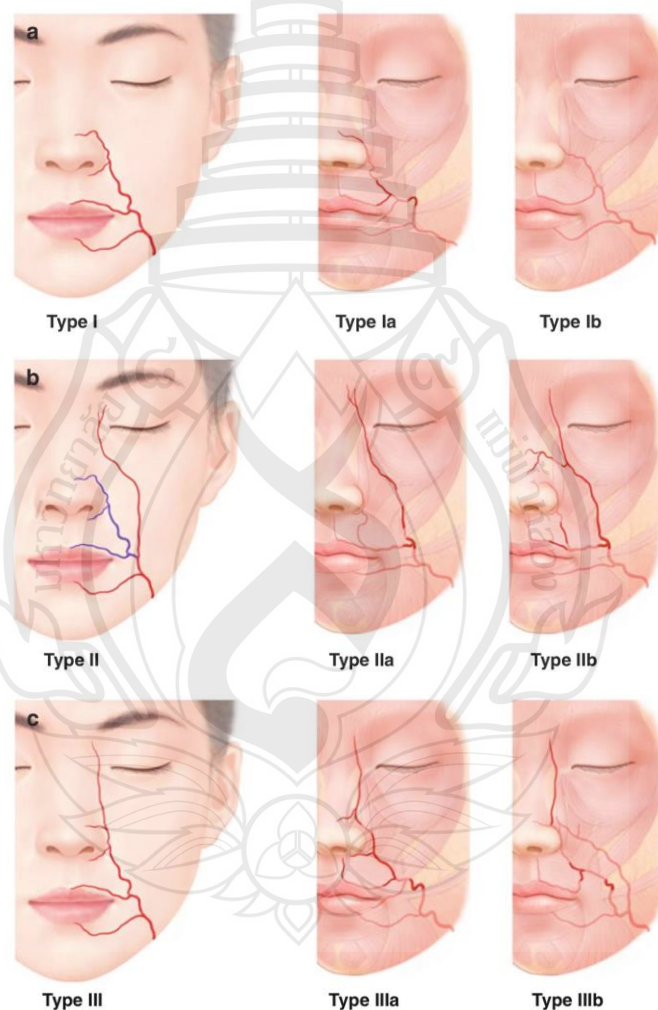
Figure 2.6 The Angular Artery

2.4.2 Typical Distribution Patterns of the Facial Artery

Depending on the direction of the artery, locations, and regions to supply, the facial artery is defined into four types. The branching pattern can be categorized into three depending on the region:

      1. Type I nasolabial pattern 51.8% (Figure 2.7a)

      2. Type II nasolabial pattern with infraorbital trunk 29.6 % (Figure 2.7b)

      3. Type III forehead pattern 18.6 % (Figure 2.7c)
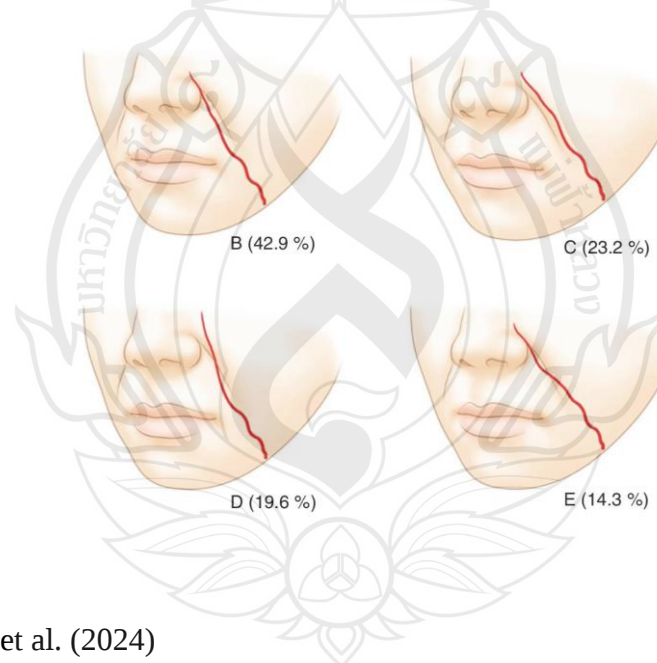
Source Kim et al. (2024, p. 38)

Figure 2.7 (a) Type I Nasolabial Pattern (b) Type II Nasolabial Pattern with Infraorbital Trunk (c) Type III Forehead Pattern

2.5 Variations in Artery Position Among Populations

2.5.1 The Facial Artery and the Angular Artery

In 93.3% of Asians, the facial artery runs close to the nasolabial fold. The artery is located 3.2 ± 4.5 mm apart from the nasal ala; and 13.5 ± 5.4 mm apart from cheilion (Kim et al., 2024). The nasal division of the facial artery is seen to traverse the medial portion of the nasolabial fold in 42.9% of individuals of Asian descent. Additionally, in 23.2% of Asians, the nasal division of the facial artery is found to travel the lateral aspect of the nasolabial fold. In a significant proportion of cases (33.9%), the artery traverses the nasolabial fold, while among Asians, a considerable percentage (43%) exhibit the facial artery ascending within a proximity of 5 mm from the nasolabial fold (Kim et al., 2024) (Figure 2.8).

Source Kim et al. (2024)

Figure 2.8 Location of Facial Artery Reference to the Nasolabial Fold

On top of that, the facial artery continues all the way to the angular artery in only 36.3% of cases among 91 Korean hemifaces. In other races, the angular was observed in 4 % of French hemi-faces, 12% of Japanese hemi-faces, 22 % of Turkish

hemi-faces, and 68 % of British hemi-faces. The true reason for the variation is still unknown, even though the investigation showed distinct angular artery incidences among different ethnicities (Kim et al., 2024).

A study on computed tomographic angiography on the Asian population by Wang et al. (2021), report the different positions of facial artery related to the nasolabial fold. Among 300 facial arteries from 150 Asian patients, a total of 72.3% of facial arteries were located medially to the nasolabial fold, 14.7% of arteries were lateral to the nasolabial fold, 5.7% of arteries crossed laterally to the nasolabial fold and 7.3% of arteries crossed medially to the nasolabial fold.

2.5.2 The Relation of Angular Artery and the Nasolabial Sulcus

In the study of three-dimensional description of the angular artery in the nasolabial fold use the computed tomography (CT scan) of Russian Caucasian by Gelezhe et al. (2020), found that the angular artery was lateral to the nasolabial sulcus in 100% of cases, the greatest distance between the artery and the nasolabial fold was at the nasal ala (13.73[3.9] mm) and the smallest distance was at the oral commissure (11.91 [7.9] mm).

2.6 Clinical Relevance of Artery Position

The facial artery is a branch of the external carotid artery. It runs along the side of the nose, contributing to the blood supply of the face. The clinical relevance of the angular artery (branch of facial artery) position is primarily associated with facial anatomy and surgical procedures.

2.6.1 Plastic and Reconstructive Surgery

2.6.1.1 Facial flaps: The surgeon may take into account the location of the nasolabial artery when designing and planning facial flaps for reconstructive surgery.

2.6.1.2 Facelifts and Rhinoplasty: procedures involving the face, such as these procedures must consider the blood supply to the skin and soft tissues, including the nasolabial region. Injury to the artery can lead to complications like hematoma, tissue necrosis, or impaired healing.

2.6.2 Maxillofacial Surgery

Cleft lip and palate repair needs to be aware of the vascular anatomy in the nasolabial region to avoid compromising blood supply during the procedure.

2.6.3 Injectable Fillers and Dermatological Procedures

Dermal fillers: in aesthetic procedures like dermal filler injections, understanding the position of the arteries is crucial to avoid inadvertent injection into the vessels. Injecting into an artery can cause vascular occlusion, leading to tissue necrosis. Knowledge of the nasolabial artery location helps to avoid complications.

2.6.4 Trauma and Emergency Medicine

Facial trauma: understanding the vascular supply in the nasolabial area is crucial. when dealing with facial trauma to ensure proper wound healing and to prevent complications related to compromised blood flow.

2.6.5 Anatomy Education

Knowledge of the nasolabial artery's position is fundamental in medical education, especially in anatomy courses and surgical training programs.

2.7 Traditional Methods for Assessing the Artery

There are several imaging techniques to visualize the anatomical variations in the arteries of face including the Nasolabial artery. They are color Doppler ultrasonography, conventional angiography, CT angiography (CTA), and Magnetic resonance angiography (MRA) (Mespreuve et al., 2020). The utilisation of colour Doppler imaging enables the enhanced visualisation of minute facial arteries, while the incorporation of depth measurement permits a comprehensive examination of the local vascular structures.

2.7.1 Conventional Angiography (CA)

Conventional angiography (CA) is a method of assessing the face arteries by using contrast material. Throughout the course of the treatment, a diminutive catheter is introduced into an artery located in the groin region and thereafter manoeuvred

through the intricate network of blood vessels in order to access the artery. Nevertheless, the administration of injections may give rise to complications such as haemorrhaging at the site of injection, injury to the vessel wall, and the formation of blood clots. Moreover, the risk of a focal neurological deficit caused by CA ranges between 0.14% and 0.5% (Mespreuve et al., 2020).

2.7.2 Computed Tomography Angiography (CTA)

CT angiography is a highly valuable modality for visualising the three-dimensional architecture of blood arteries. Complications arising from the administration of iodine contrast media and exposure to radiation remain a potential concern. In aggregate, the overall risk to patients undergoing computed tomography angiography (CTA) operations ranges from 15 to 36 instances of cancer per 1 million procedures (Mespreuve et al., 2020).

2.7.3 Magnetic Resonance Angiography (MRA)

Magnetic resonance angiography (MRA) can utilize intravenous (IV) contrast agents in order to augment the visualization of blood arteries. However, it is important to acknowledge that the administration of IV gadolinium injection carries inherent risks that may provide possible harm to the patient.

2.8 Advancements in Ultrasound Imaging Technology

Real-time visualization of the anatomical details of the patient is achievable through the utilization of ultrasonic examination, a non-invasive imaging modality. Both healthy skin and problematic lesions are assessed using skin ultrasound examinations. Doppler ultrasound offers the potential to assess the location and the course of arteries, to measure the intensity of blood flow, and to evaluate the waveform in case of vascular injury without the administration of a contrast agent. Ultrasound waves penetrate the skin and depending on the underlying structures, will be transmitted through fluid-containing elements, or reflected by hard components (Schelke et al., 2022).

A probe and a processor are the two main components of an ultrasonic device. To enter body tissue, the probes will produce a sound wave. During their interaction with the tissue, sound waves weaken as they are absorbed or scattered. The transducer (The probe) plays a crucial role in cutaneous evaluation and high-frequency transducers have high resolution and low penetration, excellent for superficial evaluation of the skin with a minimum frequency of 15 MHz (Vasconcelos-Berg et al., 2023).

Images of the common facial tissue types, including the fascia, muscle, bone, and the dermis and subdermal layers. The blood vessels are anechoic and circular to oval in shape, while the fibrous tissue exhibits, hyperechoic streaks (Table 2.2). The dermis is a small hypoechoic band. Because bone and fascia are dense, hyperechoic structures, the muscle displays hypoechoic features (Velthuis et al., 2021).

Table 2.2 Grayscale of Echogenicity

Grayscale of Echogenicity	
Echogenicity	The ability of tissue or substance to reflect sound waves and produce echoes
Anechoic	No echoes; appears black on ultrasound.
Hypoechoic	Reflective and lower amount of echoes appears as varying shades of dark grey.
Hyperechoic	Highly reflective and echo-rich when compared to neighboring structures, appears as varying shades of light grey.
Isoechoic	Having similar echogenicity to a neighboring structure.

Source Schelke (2018)

The Pattern of Fillers by Ultrasound

Urdiales-Gálvez et al. (2021) studied the ultrasound patterns of different dermal filler materials used in aesthetics in sixty patients to assess the patterns of fillers. They identify four patterns:

1. Heterogenous, characterized by alternating hyperechoic and anechoic areas which are visualized in soft tissue in heterogeneous ways. This pattern is seen in healthy skin and with integrated Hyaluronic acid fillers.

2. Fine grain snow, characterized by alternating hyperechoic imaging, with posterior echogenic shadows, and it is seen with silicone injection.
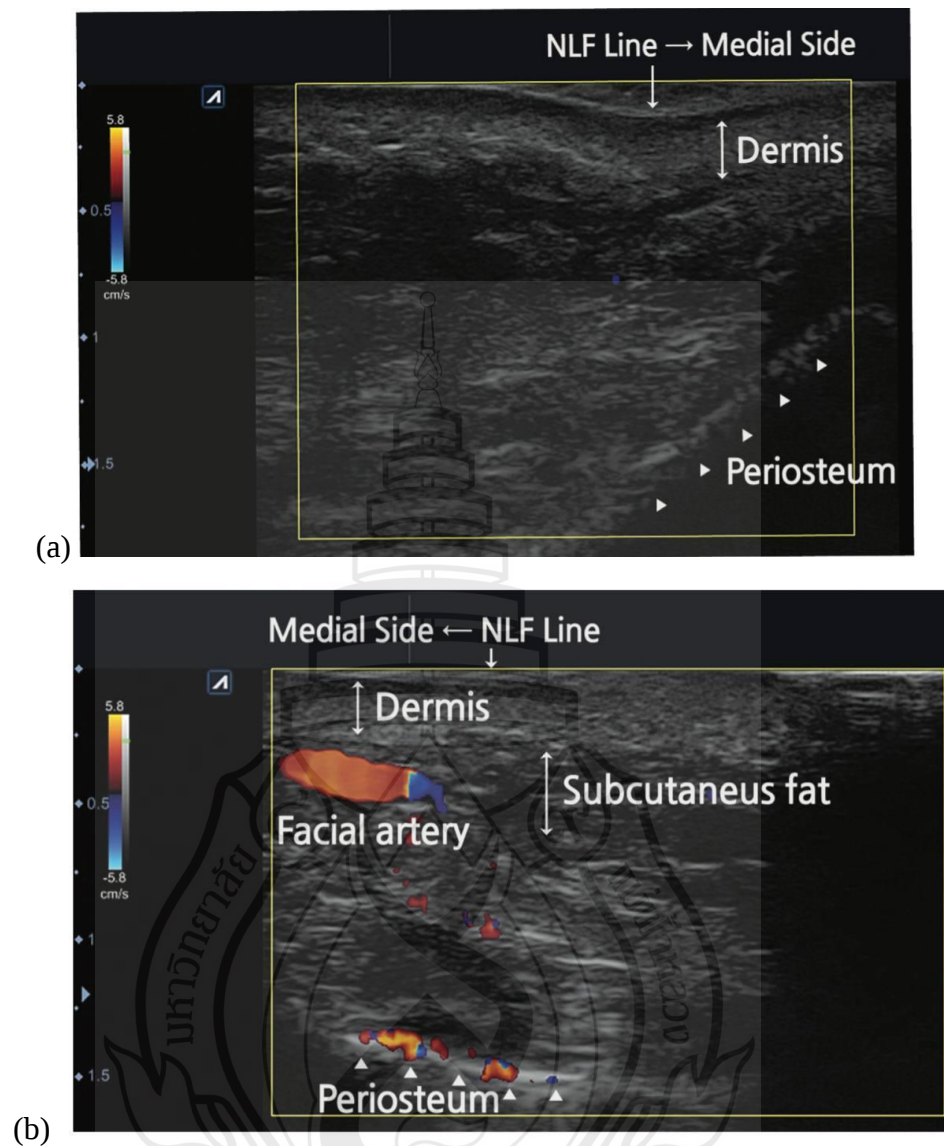
3. Coarse grain snowfall is typified by the presence of hyperechoic images that are uniformly dispersed throughout the tissue and seen in calcium hydroxyapatite and polymethyl methacrylate-based fillers.

4. Globular, typical cystic imaging. The observed pattern consists of polyalkylamides and polyacrylamides, as well as HA-based fillers administered shortly following injection.

2.9 Previous Studies on Ultrasound Imaging

The evaluation of facial artery course variations in relation to the nasolabial region by ultrasound in 66 hemifaces of 33 patients mentioned the most common course was type 1, and 59.1% had an angular branch as an end (Shen et al., 2023). This study also found that 50% of facial artery situated inferior to the nasolabial fold (Shen et al., 2023). Moreover, the artery detected in the dermis and subcutaneous tissue in the facial artery-nasolabial fold relationship.

In the study by Lee et al. (2020), a single-center, retrospective, case series study, DUS to visualize the arterial anatomy of the nasolabial fold in 80 cases: detected the facial artery in the subdermal layer 13%, the subcutaneous layer 29%, the muscular layer 24% and the submuscular layer 4%, also 31% located lateral to nasolabial fold (Figure 2.9 a &b).

(a)

(b)
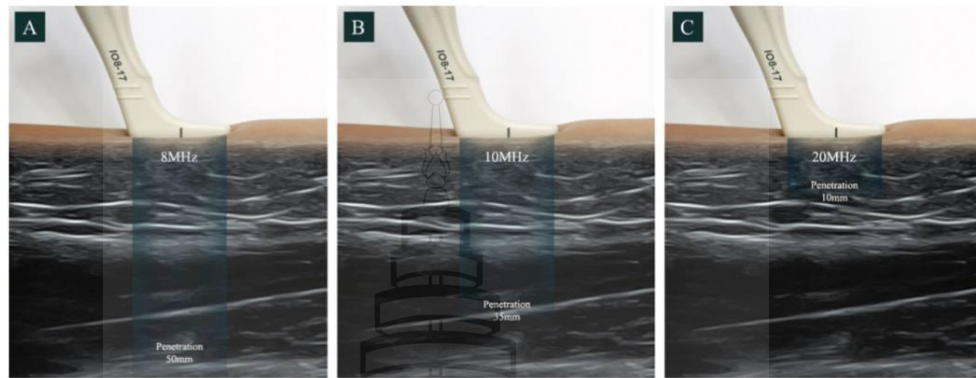
Source Lee et al. (2020)

Figure 2.9 (a) Ultrasound of Nasolabial Fold Structures with no Artery Detection (b)
　　　　　　Location of the Facial Artery in the Nasolabial Fold

Another study by Lee et al. (2023), mentioned the use of ultrasound to detect
the facial artery pathway in nasolabial fold correction, the facial artery presented
transversing the nasolabial fold area (69%) or lateral to the nasolabial fold area (31%)
and he has mentioned about the wave frequency 8 MHz can provide a depth of

visualization of approximately 50mm, while 20MHz gives a depth of 10mm. So, 8-17 MHz can cover all the facial layer detection (Figure 2.10).

Figure 2.10 Different Depths of Visualization

2.10 Related Studies
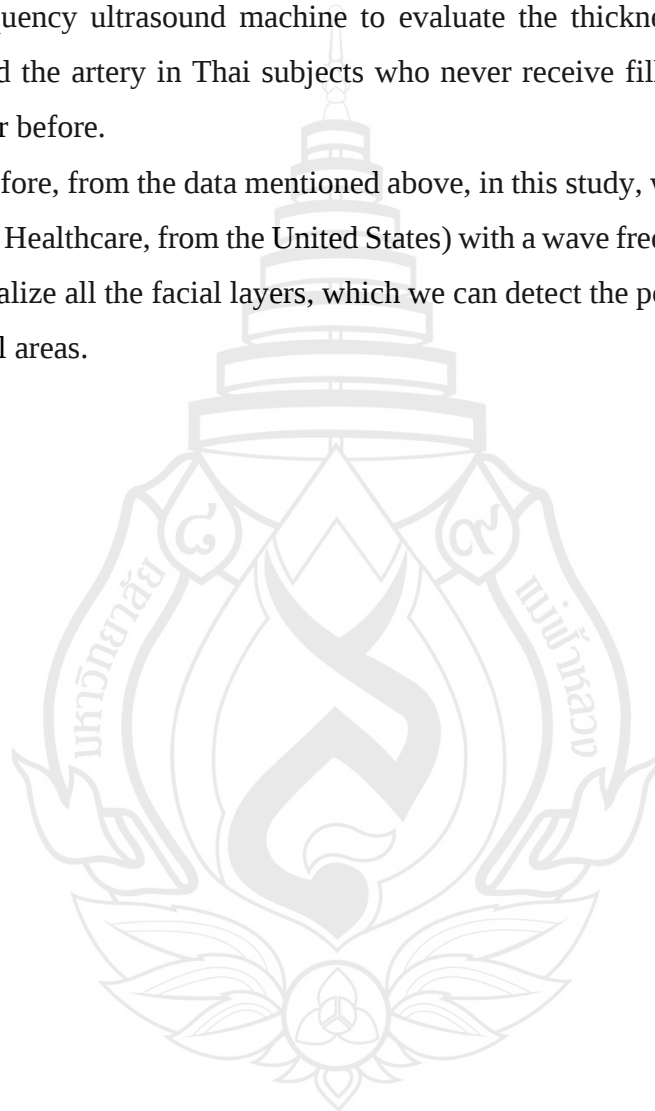
Recent studies mentioned the use of ultrasound to visualize certain areas such as lips, jawline, midface, nose area, forehead, and temples. And used to guide filler injection (Lee et al., 2020), botulinum toxin injection, threat lifting, a guide for lipo-filling, and the use of ultrasound to handle complications (nodule, edema, granulomas, abscess, etc.) (Schelke et al., 2023).

There are several studies that using ultrasound machine to visualize the facial structures and the vessels in different location like the anatomy study of temporal region by Zhao et al. (2023) mentioned about the visualize thickness and position of vessels, skin, subcutaneous fat, fascia, muscle at various point ,and he found the significant different between the superficial fat pad and deep temporal fat pad and the slightly different of vessels. However, there are no discussion or utilise any imaging apparatus to study on the nasolabial structure in Thai subjects. Moreover, the study by Lee et al. (2020), About the nasolabial correction with hyaluronic acid filler which is used the

doppler ultrasound guided found the variation of artery position in the nasolabial area with the same Ethnic background.

To our knowledge, the study of the artery and measure thickness the nasolabial fold structure in Thai people for who no to receive filler and have received filler by the ultrasound machine has not been published in the literature. Therefore, we aim to utilize the high-frequency ultrasound machine to evaluate the thickness of nasolabial fold structures and the artery in Thai subjects who never receive filler injection and have received filler before.

Therefore, from the data mentioned above, in this study, we will use ultrasound (VENUE GE Healthcare, from the United States) with a wave frequency of 2.5-20 MHz probe to visualize all the facial layers, which we can detect the position of the artery of the nasolabial areas.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Study Design

An observational cross-section study, a one-time examination by high-frequency ultrasound on the group who has received filler and never received filler to specify the depth and position of arteries and the structure of nasolabial folds. Outcome measurements included the depth and position of arteries, and the thickness of nasolabial fold structures such as skin, subcutaneous, SMAS, and bone.

3.2 Population Selection

The study was conducted in groups of Thai people who came to Mae Fah Luang University Hospital, healthy males and females.

3.3 Study Location

Mae Fah Luang University Hospital, Bangkok

3.4 Sample and Sample Size Determination

The volunteers were taken from those who came to Mae Fah Luang Hospital for the filler injection on NLFs. The data was collected before the filler injection. In addition, data was collected for subjects who never received filler and have received filler before, age range of 25-50 years with grading nasolabial fold severity scores as grades 1, 2, 3, 4, and 5 respectively.

The reference data was taken from the research article "The Anatomy Study of Temporal Region based on the Ultrasound Investigation: A Spatial Structure Study'' by

Zhao et al. (2023). A total of 30 subjects, both Male and Female with 60 temporal areas. The mean age was 26.7± 3.1 years old.

Since the methods of the study have been conducted in another country, we are adopting a sample size, a cross-sectional study (Zhao et al., 2023). Therefore, the subjects in this research was 30 subjects with a 10% dropout rate. So, the total number of subjects enrolled were 33 subjects, both Males and Females with 66 nasolabial folds, age range of 25-50 years.

3.5 Selection Criteria

3.5.1 Inclusion Criteria

The following criteria was used to select and include all prospective volunteers.

3.5.1.1 Healthy individuals

3.5.1.2 Both male and female

3.5.1.3 Age between 25-50 years old

3.5.1.4 Volunteers who never received filler injection and have received filler before on nasolabial fold.

3.5.1.5 Volunteer with no other treatments like fat grafting.

3.5.1.6 Volunteers were required to sign consent documents outlining the benefits, risks, and publication of photographs.

3.5.1.7 Volunteers were required to be able to adhere to the study's instructions.

3.5.2 Exclusion Criteria

3.5.2.1 History of facial operation.

3.5.2.2 Known Facial Vascular Malformation

3.5.2.3 History of Thread Lifting.

3.5.2.4 Underlying diseases such as psychiatric diseases, HIV, autoimmune diseases.

3.5.2.5 Pregnancy or lactation during a period of study.

3.5.2.6 Individuals had undergone previous trauma in nasolabial region.

3.5.2.7 Individual who was allergic to ultrasound conducting gel.

3.5.3 Discontinuation Criteria

Volunteers would like to discontinue the program for any reason.

3.5.4 Early Termination Criteria

3.5.4.1 Volunteers had any side effects of ultrasound conducting gel like itching and burning.

3.5.4.2 The research was terminated in case severe allergic reactions occur.

3.6 Materials and Equipment

3.6.1 Ultrasound machine (VENUE GE Healthcare, 2.4-20 MHz)

3.6.2 Ultrasound conducting gel.

3.6.3 Research declaration form

3.6.4 OPD card

3.6.5 Informed Consent Form

3.6.6 Clinical Evaluation Record Form

3.7 Study Procedures

3.7.1 Research Subject's Preparation

3.7.1.1 This research was conducted after approval by Mae Fah Luang Ethical Committee.

3.7.1.2 All subjects were selected for examination by using inclusion and exclusion criteria.

3.7.1.3 The researcher provided a comprehensive description of the study's objectives, methodologies, and potential advantages.

3.7.1.4 The subjects were informed and willing to sign an informed consent for admission to the study.

3.7.1.5 The subject's information was recorded.

3.7.1.6 The standard photographs were taken and WSRS scores were assessed.

3.7.1.7 The data was collected by ultrasound scan.

3.7.2 Examination Process

3.7.2.1 Before the examination procedure, all volunteer's face was cleaned. then three points were noted (A, B, C) following the nasolabial folds line from the lateral of the nose to the 1-2cm lateral to oral commissure.

3.7.2.2 Ultrasound conducting gel was applied to the nasolabial area before starting the examination.
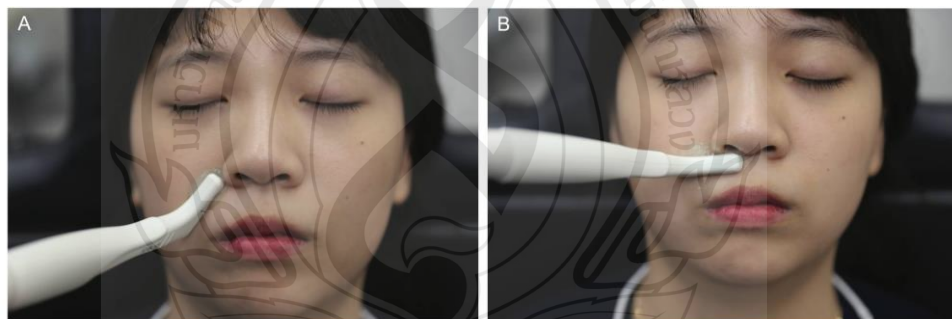
3.7.2.3 All participants received high-frequency ultrasound (VENUE, GE Healthcare, United States) for a one-time examination on both sides of the nasolabial areas.

3.7.2.4 The hockey stick probe was placed along each point to map the depth and position of the artery and measure the thickness of the nasolabial structures at each point.

3.7.2.5 The thickness of the nasolabial structure such as skin, Subcutaneous, SMAS, and bone was measured.
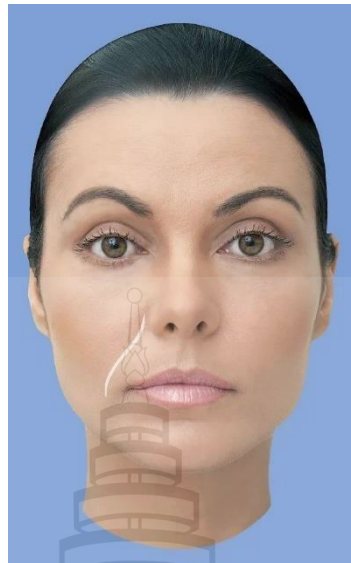
3.7.2.6 Each subject took about 10-15 minutes.

3.7.2.7 The ultrasound gel was wiped off and then the volunteer's face was rinsed off with water.

Source Lee et al. (2020)

Figure 3.1 The Examination Area

Figure 3.2 Nasolabial Folds Create Points

High-frequency
Ultrasound scanning

before procedure

During scanning

- Assessed WSRS score of the folds.
- Standard photography on both sides of NLF.

- Mapped the position and deep of the artery at specific point.
- Measured the thickness of the nasolabial structures such as skin, subcutaneous, SMAS and bone .
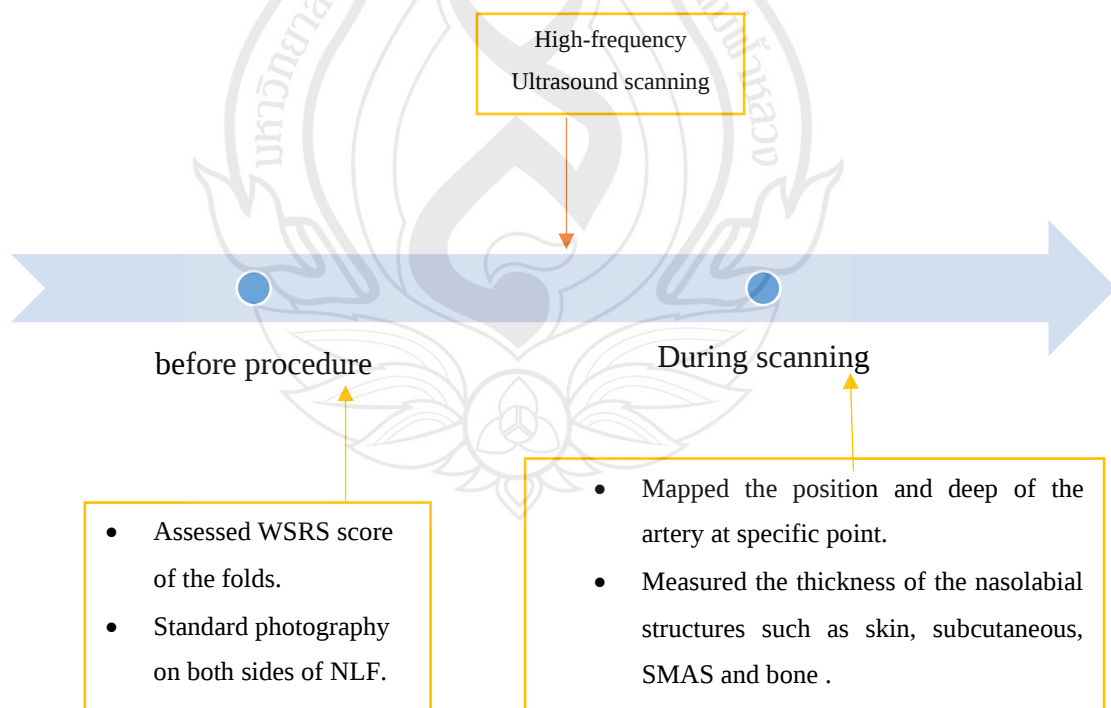
Figure 3.3 The Research Procedure

3.8 Outcome Measurement and Data Collection

All data were recorded in the case record form.

3.8.1 Demographic data: age, gender, history of filler

3.8.2 The nasolabial severity score using wrinkle severity scores.

3.8.3 The depth and position of the artery in the nasolabial region.

3.8.4 The thickness of Nasolabial structures such as skin, subcutaneous, and SMAS.

3.9 Data Analyses

Descriptive Statistics

1. Using descriptive statistics analysis, information like percentages (position of artery), means, medians, ranges, and standard deviations (for age, the thickness of each nasolabial layer, and depth of artery) were used to describe the profile data of the subjects.

2. Distribution of outcome by age, history of filler, wrinkle severity score, gender demographic.

3.10 Ethical Consideration

All protocols of the research were conducted only after approval by the human research committee at Mae Fah Luang University (Approval No. EC 23273-20) and this study was conducted by following the guideline of Good Clinical Practice (GCP). The researcher has completed Good Clinical Practice and the Human Research Ethics training course. Volunteers experienced enhanced levels of confidence when they were aware that the rights, safety, and welfare of study subjects were respected in accordance with ethical norms.

For general understanding, considerations were as follows.

1. An evaluation and approval of the research by an ethics committee.

2. Volunteers completely understand the objective, methodology, and possible side effects of the research.

3. Prior to participating in the study, volunteers will provide their informed consent by signing a consent form. Individuals have the option to depart at any given moment without incurring any negative consequences.

4. In the event of the occurrence of a problem, the researcher assumed responsibility and fully helped the volunteers.

5. This research was free of charge.

6. All data provided was held in strict confidentiality. The researcher replaced the file names of the patients'pictures with serial numbers, ensuring that both the names and the numbers are identical.

7. During the research, serious adverse events were reported to the ethics committee.

8. This study was a cross-sectional and the study was conducted only a one-time examination, at the end of the study, we were able to see the clear tissue structures, position of the artery and the course of facial artery on nasolabial area, this will beneficial for volunteers and also evidence that in order to reduce the complication of filler we can use ultrasound to map the facial structures of inject side and the position of vessels.

CHAPTER 4

RESULTS

The research was conducted to study the anatomy of the nasolabial fold region by High-Frequency Ultrasound on both filler and non-filler injection subjects. The results were reported in 2 parts:

    1. General characteristics of subjects

    2. The parameters Measurement

       1) Soft tissue thickness

         A. Soft tissue thickness of Point A

         B. Soft tissue thickness of Point B

         C. Soft tissue thickness of Point C

       2) Depth and the position of the facial artery

         A. Depth of facial vessel

           A) Depth of facial artery in all subjects

           B) Depth of facial artery in filler injected and no filler injected.

         B. Position of facial vessel

           A) Position of vessels in all subjects

           B) Position of vessels in filler injected and no filler injected.

4.1 General Characteristics

Thirty-three patients were screened for the study, a total of 66 nasolabial folds (left and right), 7 males and 26 females were enrolled, and all the patients completed the study at Mae Fah Luang University Hospital, Bangkok. The patients were recruited from an outpatient population. The demographic data of all volunteers is demonstrated in Table 4.1. The age ranged from 25 to 46 years, with a mean age was 33.79 years.

The volunteers who have received filler injections before were 8 and no filler was 25. None of them were taking any medication.

Table 4.1 General Characteristics (N=33)

Demographic data	History of filler	
	Yes (n=8)	No (n=25)
Gender, n(%)		
Male	2 (25)	5 (20)
Female	6 (75)	20 (80)
Age (years), mean±SD	36.25±6.58	33±6.34
(min - max)	(28-46)	(25-44)
Nasolabial severity score, n(%)		
Right side		
1	0 (0)	2 (8)
2	3 (38)	9 (36)
3	4 (50)	12 (48)
4	0 (0)	2 (8)
5	1 (12)	0 (0)
Left side		
1	0 (0)	2 (8)
2	3 (38)	9 (36)
3	4 (50)	12 (48)
4	0 (0)	2 (8)
5	1 (12)	0 (0)

8 volunteers with a history of filler injections, 75% were female and 25% were male. The mean age was 36.25±6.58 years, with the minimum being 28 years and the maximum being 46 years. The nasolabial severity score on the right and left sides was mostly at level 3 (50%), followed by level 2 (38%), and level 5 (12%), respectively.

25 volunteers never received filler, 80% were female and 20% were male. The mean age was 33±6.34 years, with the minimum age being 25 years and the maximum being 44 years. The nasolabial severity score on the right and left sides was mostly at level 3 (48%), followed by level 2 (36%), and levels 1 and 4 (8%), respectively.

4.2 Parameter Measurement

This study measured the Nasolabial region on both sides of each subject. The right side of the nasolabial region is marked in three points (Figure 4.1): point A or RN1 (at the lateral of the nose) which is considered the common location for filler injection, point C or RN3 (at 1-2cm from the corner of the mouth) and Point B or RN2 (at the middle point between point A and point C) and the left side of nasolabial fold are LN1, LN2, LN3 respectively.

Figure 4.1 Nasolabial Folds Created Points A, B, And C Both the Right and Left, Hockey Stick Probe

Among 8 people who have received filler injections before, we found 6 people have remaining filler particles (Figure 4.2, 4.3, 4.4). However, the injection duration and the filler types may play an important role in the tissue.
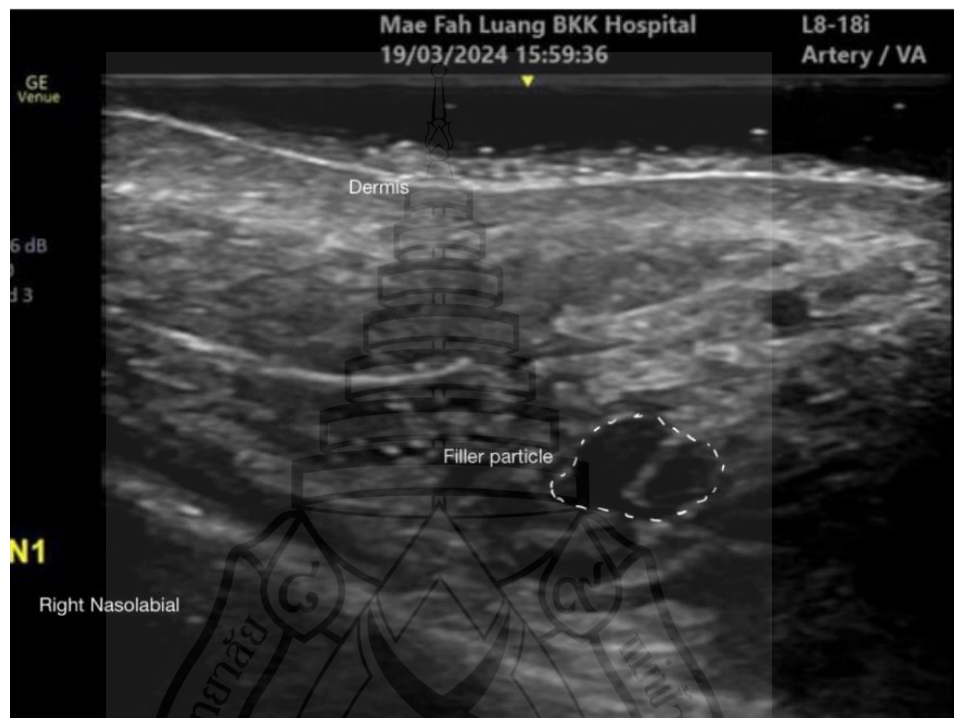
Figure 4.2 Anechoic Mass on the Right Nasolabial Fold (Point A), 30-Year-old Male Volunteer after 3 Days of HA Filler Injection, a Dot Line Indicates Filler Particles
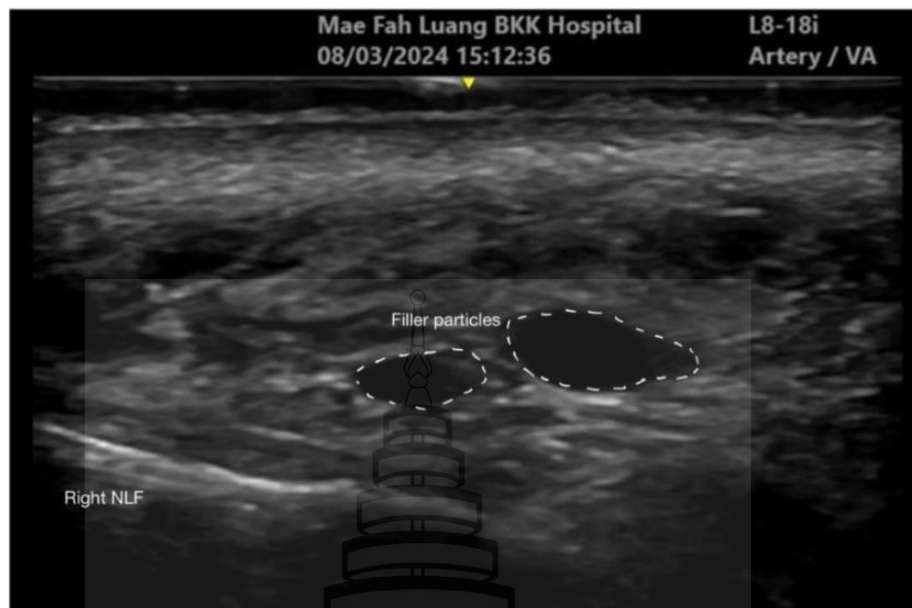
Figure 4.3 Anechoic Masses on the Right Side NLF (Point B; Midpoint), HA Filler
Injection on 43-year-old Female Volunteer after 1-year Filler Injection,
Dots Line Indicates Filler Particles
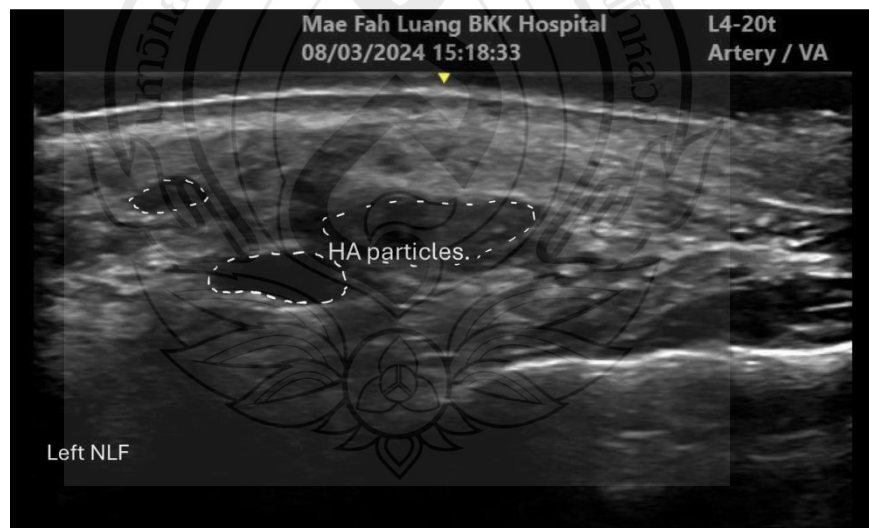
Figure 4.4 HA Filler Particles on the Left Side NLF, Measured by Wide-band Linear
Array Probe on a 43-year-old Female Volunteer after 1-year Filler Injection,
a Dot Line Indicates Filler Particles

4.2.1 Soft Tissue Thickness

1. The thickness of each nasolabial layer (d1-d4) at point A left and right. At points B and C, the thickness of each layer (d1-d3) left, and right were measured.

2. The position and depth of the facial and angular artery (point A) at each point were measured.

The layer arrangement of the fascial planes of the face (Figure 4.3): skin (which has the epidermis and dermis), subcutaneous fat, musculoaponeurotic, comprised of the SMAS and facial muscles, loose areolar tissue or deep fat, periosteum, and deep fascia (Whitney, 2024). The anatomical layer of the right-side nasolabial fold by high-frequency ultrasound of each point is shown in Figure 4.6.

4.2.1.1 Soft tissue thickness at point A:

The participant with no filler usage history had a mean thickness of the skin on the right and left sides was found to be 1.82±0.40 mm and 1.95±0.32 mm, respectively. The mean thickness of the subcutaneous layer (from subdermal to subcutaneous) on the right and left sides was 3.08±0.84 mm and 2.93±0.79 mm, respectively. The mean thickness of SMAS (from the skin to SMAS) on the right and left sides was 4.98±1.07 mm and 4.84±0.98 mm, respectively. The mean thickness from skin to bone on the right and left sides was 9.72±1.87 mm and 10.56±1.99 mm, respectively.

The participant with filler usage history had a mean thickness of the skin on the right and left sides was found to be 1.45±0.43 mm and 1.66±0.45 mm, respectively. The mean thickness of the subcutaneous layer (from subdermal to subcutaneous) on the right and left sides was 2.84±0.61 mm and 3.24±0.39 mm, respectively. The mean thickness of SMAS (from the skin to SMAS) on the right and left sides was 4.48±1.11 mm and 4.85±0.56 mm, respectively. The mean thickness from skin to bone on the right and left sides was 9.8±2.39 mm and 11.76±1.89 mm, respectively (Table 4.2)

Table 4.2 Soft Tissue Thickness at Point A (Lateral of Nose) (N=33)

Soft tissue thickness (mm.)	Right		Left	
	mean±SD	min - max	mean±SD	min - max
No filler group (n=25)				
Thickness of skin	1.82±0.40	1–2.6	1.95±0.32	1.4-2.5
Thickness from subdermal to subcutaneous	3.08±0.84	1.6-5.1	2.93±0.79	1.7-4.8
Thickness from skin to SMAS	4.98±1.07	3.1-7.1	4.84±0.98	3.2-6.9
Thickness from skin to bone	9.72±1.87	6.3-12.9	10.56±1.99	6.8-14.7
Filler group (n=8)				
Thickness of skin	1.45±0.43	0.9-2.0	1.66±0.45	1.0-2.3
Thickness from subdermal to subcutaneous	2.84±0.61	2.0-3.7	3.24±0.39	2.6-3.7
Thickness from skin to SMAS	4.48±1.11	3.1-6.5	4.85±0.56	4.3-5.8
Thickness from skin to bone	9.8±2.39	7.1-13.1	11.76±1.89	8.4-14.7

4.2.1.2 Soft tissue thickness at point B:

The layers that we can detect by High-Frequency Ultrasound at Point B: are skin, Subcutaneous, and SMAS. The participant with no filler usage history had a mean thickness of the skin on the right and left sides was found to be 2.05±0.33 mm and 2.03±0.31 mm, respectively. The mean thickness of the subcutaneous layer (from subdermal to subcutaneous) on the right and left sides was 3.11±0.60 mm and 3.52±0.64 mm, respectively. The mean thickness of the SMAS layer (from the skin to SMAS) on the right and left sides was 5.20±0.65 mm and 5.63±0.81 mm, respectively.

The participant with filler usage history had a mean thickness of the skin on the right and left sides was found to be 1.81±0.35 mm and 1.99±0.35 mm, respectively.

The mean thickness of the subcutaneous layer (from subdermal to subcutaneous) on the right and left sides was 3.24±0.41 mm and 3.55±1.00 mm, respectively. The mean thickness from the skin to SMAS on the right and left sides was 5.03±0.57 mm and 5.45±1.12 mm, respectively. The descriptive statistics of soft tissue thickness at point B are shown in Table 4.3.

Table 4.3 Soft Tissue Thickness at Point B (Midpoint Between Points A and C)

Soft tissue thickness (mm.)	Right		Left	
	mean±SD	min - max	mean±SD	min - max
No filler group (n=25)				
Thickness of skin	2.05±0.33	1.5-2.8	2.03±0.31	1.1-2.5
Thickness from subdermal to subcutaneous	3.11±0.60	2.1-4.2	3.52±0.64	2.4-5.2
Thickness from skin to SMAS	5.20±0.65	3.9-6.6	5.63±0.81	3.4-7.0
Filler group (n=8)				
Thickness of skin	1.81±0.35	1.4-2.4	1.99±0.35	1.4-2.8
Thickness from subdermal to subcutaneous	3.24±0.41	2.7-3.9	3.55±1.00	2.7-5.8
Thickness from skin to SMAS	5.03±0.57	4.1-5.6	5.45±1.12	4.1-7.3

4.2.1.3 Soft tissue thickness at point C:

The layers that we can determine are the same as point B which are skin, subcutaneous, and SMAS. The participants with no filler usage history had a mean thickness of the skin on the right and left sides were found to be 1.84±0.34 mm and 1.82±0.41 mm, respectively. The mean thickness from subdermal to subcutaneous on the right and left sides was 3.03±0.67 mm and 3.48±0.73 mm, respectively. The mean thickness of the SMAS layer (from the skin to SMAS) on the right and left sides was 4.92±0.83 mm and 5.04±1.24 mm, respectively.

The participant with filler usage history had a mean thickness of the skin on the right and left sides was found to be 1.63±0.33 mm and 1.71±0.27 mm, respectively. The mean thickness of the subcutaneous layer (from subdermal to subcutaneous) on the right and left sides was 3.43±1.08 mm and 3.93±1.21 mm, respectively. The mean thickness of the SMAS layer (from the skin to SMAS) on the right and left sides was 4.95±1.30 mm and 5.54±1.18 mm, respectively. The descriptive statistics of soft tissue thickness at point C (1-2 cm near the corner of the mouth) are shown in Table 4.4. Display Bar graph and error bar showing soft tissue thickness at points A, B, and C on the right and left side shown in Figure 4.5.

Table 4.4 Soft Tissue Thickness at Point C (1-2 cm Near the Corner of the Mouth)

Soft tissue thickness	Right		Left	
(mm.)	mean±SD	min - max	mean±SD	min - max
No filler group (n=25)				
Thickness of skin	1.84±0.34	1.2-2.4	1.82±0.41	1.2-2.8
Thickness from subdermal to subcutaneous	3.03±0.67	1.9-5.0	3.48±0.73	2.1-4.9
Thickness from skin to SMAS	4.92±0.83	3.5-6.6	5.04±1.24	0.7-7.1
Filler group (n=8)				
Thickness of skin	1.63±0.33	1.0-2.0	1.71±0.27	1.4-2.1
Thickness from subdermal to subcutaneous	3.43±1.08	2.2-5.0	3.93±1.21	2.5-5.9
Thickness from skin to SMAS	4.95±1.30	3.3-6.8	5.54±1.18	3.7-6.9
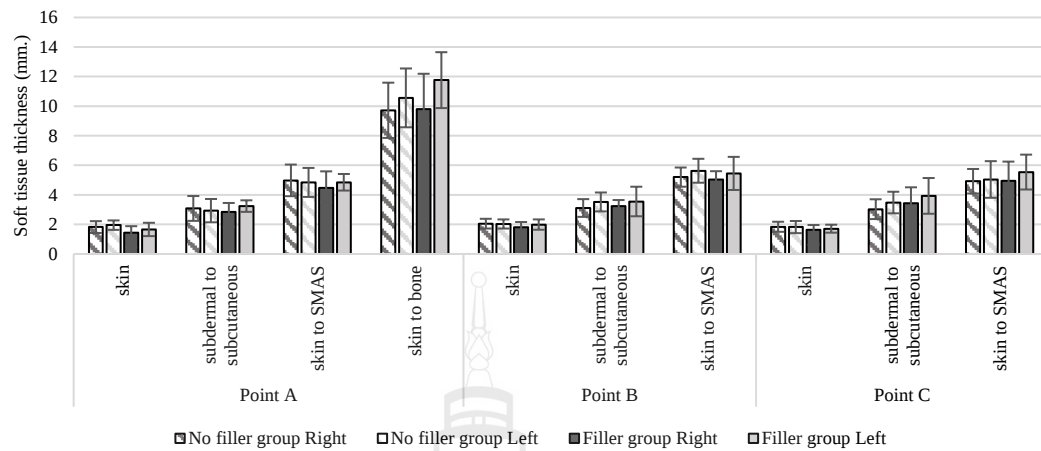
Figure 4.5 Display Bar Graph and Error Bar Showing Soft Tissue Thickness at Points A, B, and C on the Right and Left Side, Including a History of Filler Injection
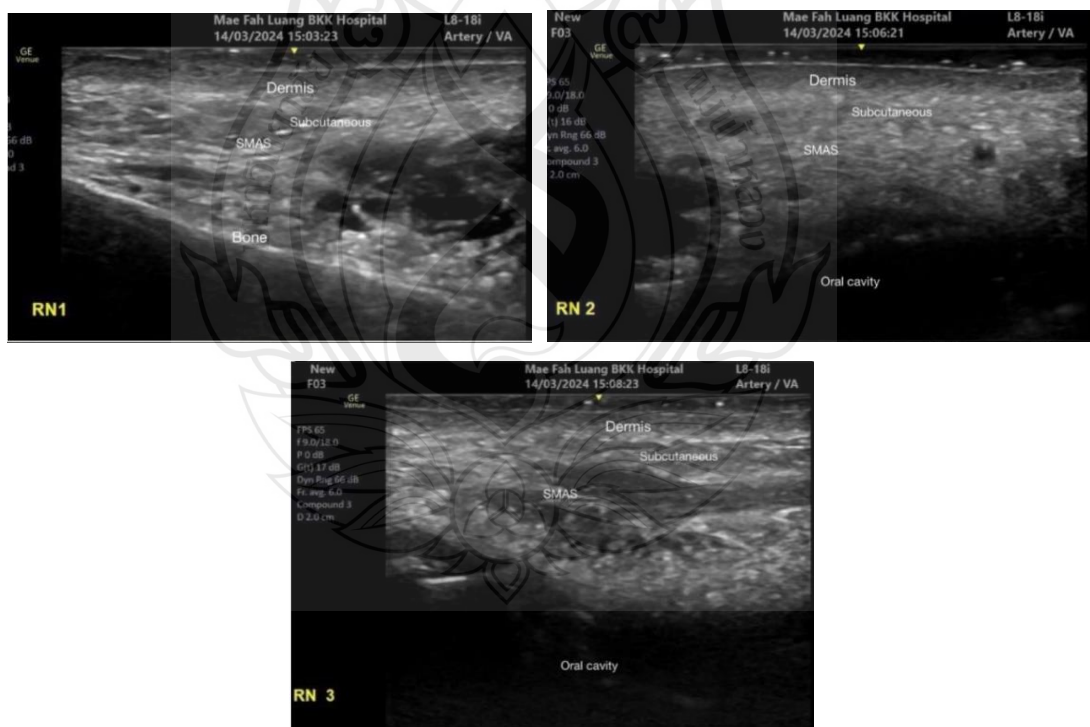

Figure 4.6 Anatomical Layer of the Right-Side Nasolabial Fold by High-Frequency Ultrasound of Each Point A (RN1), B (RN2), and C (RN3), Indicates Layer in the Pictures

4.2.2 Depth and Position of the Nasolabial Vessel

Nasolabial vessels and Position

The facial artery splits off from the external carotid artery, course the inferior border of the mandible, and curves upward to the lateral aspect at pre masseteric notch beneath the platysma. Located within the buccal space, there exists a tortuously rising structure with a diameter measuring roughly 2.14 mm (Isaac et al., 2023). The facial artery follows its route in the nasolabial fold, where it divides into the inferior and superior labial branches, and lateral nasal branch and forms anastomoses with the septa and alar branches, the dorsal nasal branch. It ultimately concludes its course as the angular artery (Figure 4.7).
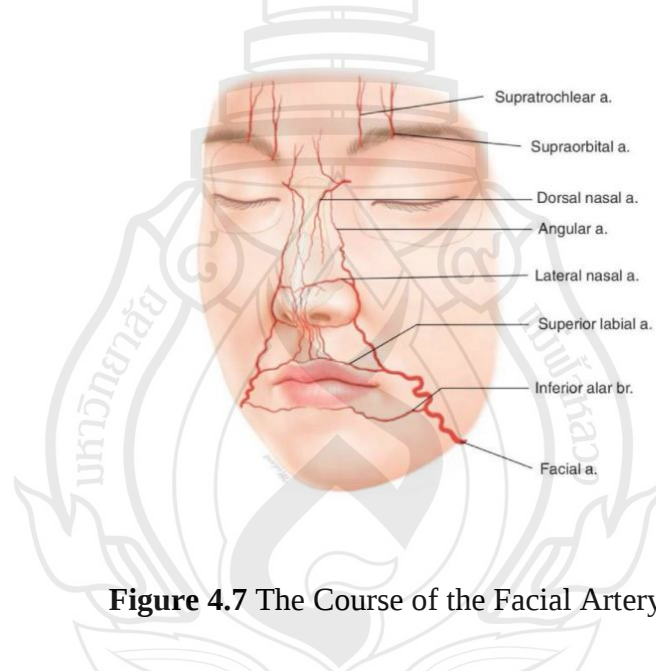
Figure 4.7 The Course of the Facial Artery

The angular artery is a terminal branch of the facial artery. It ends at the medial canthus region and branches to the medial side of the eyelid and the nose. This artery sometimes branches from the ophthalmic artery rather than from the facial artery. The angular artery courses between the space and the deep medial cheek fat compartment, not directly on the periosteum (Figure 4.8).
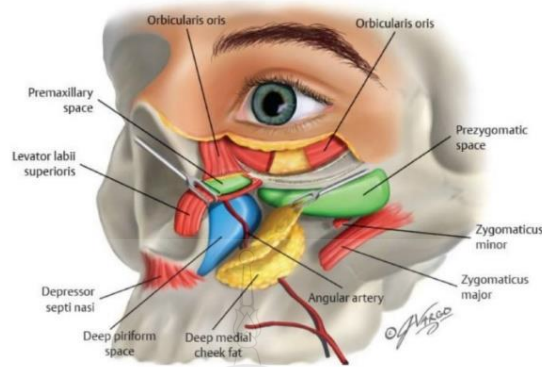
Figure 4.8 The Angular Artery and Piriform Fossa

4.2.2.1 Depth of the Nasolabial Artery

1. Depth of the Nasolabial artery (facial artery) in all subjects (n=33)

At Point A, the mean depth of the nasolabial vessel (the angular artery) at point A on the right and left sides was found to be 5.84±2.37 mm and 6.42±2.22 mm, respectively (Table 4.5).

At Point B, the mean depth of the Facial artery at point B on the right and left sides was found to be 5.05±1.76 mm and 5.58±2.45 mm, respectively (Table 4.5).

At Point C, the mean depth of the Facial artery at point C on the right and left sides was found to be 6.03±1.79 mm and 6.69±1.77 mm, respectively (Table 4.5). Display Bar graph and error bar showing the depth of the nasolabial vessel at points A, B, and C on the right and left sides shown in Figure 4.9.

Table 4.5 Depth of the Nasolabial Vessel at Points A, B, and C

Depth of nasolabial vessel (mm.)	Right			Left		
	n	mean±SD	min - max	n	mean±SD	min - max
Point A (Lateral of nose)	30	5.84±2.37	2.4-13.7	32	6.42±2.22	2-10.3
Point B (Midpoint between points A and C)	25	5.05±1.76	2.8-9.5	23	5.58±2.45	2.5-11.4
Point C (1-2cm near the corner of the mouth)	32	6.03±1.79	1.5-11.2	33	6.69±1.77	2.2-9.7
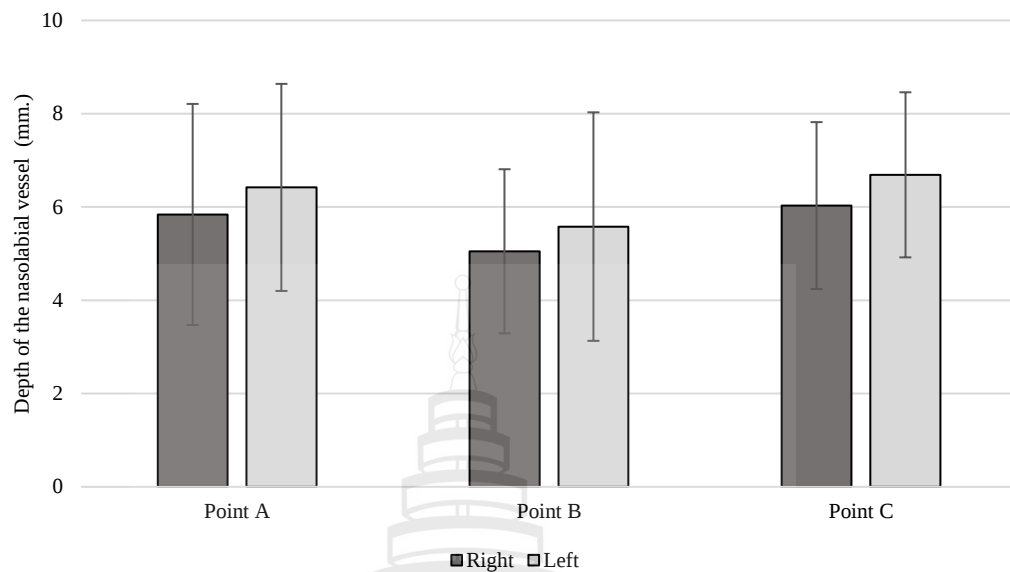
Figure 4.9 Display Bar Graph and Error Bar Showing the Depth of the Nasolabial Vessel at Points A, B, and C on the Right and Left Sides

2. Depth of nasolabial artery (facial artery) in Filler and Non-filler

The participant with no filler usage history had a mean depth of the nasolabial vessel at point A on the right and left sides was found to be 5.55±1.69 mm and 6.08±2.24 mm, respectively. The mean depth of the nasolabial vessel at point B on the right and left sides was found to be 5.02±1.84 mm and 5.37±2.41 mm, respectively. The mean depth of the nasolabial vessel at point C on the right and left sides was found to be 6.15±1.75 mm and 6.34±1.75 mm, respectively (Table 4.6).

The participant with filler usage history had a mean depth of the nasolabial vessel at point A on the right and left sides found to be 6.63±3.72 mm and 7.61±1.81 mm, respectively. The mean depth of the nasolabial vessel at point B on the right and left sides was found to be 5.15±1.66 mm and 6.17±2.71 mm, respectively. The mean depth of the nasolabial vessel at point C on the right and left sides was found to be 5.68±1.99 mm and 7.79±1.43 mm, respectively (Table 4.6). Display Bar graph and error bar showing the depth of the nasolabial vessel at points A, B, and C on the right and left sides shown in Figure 4.10.

Table 4.6 Depth of the Nasolabial Vessel

Depth of nasolabial vessel (mm.)	No filler group (n=25)						Filler group (n=8)					
	Right			Left			Right			Left		
	n	mean±SD	min - max	n	mean±SD	min - max	n	mean±SD	min - max	n	mean±SD	min - max
Point A	22	5.55±1.69	3.1-9.6	25	6.08±2.24	2.0-10.2	8	6.63±3.72	2.4-13.7	7	7.61±1.81	5.1-10.3
Point B	19	5.02±1.84	2.8-9.5	17	5.37±2.41	2.8-11.4	6	5.15±1.66	3-8.1	6	6.17±2.71	2.5-9.9
Point C	24	6.15±1.75	3.3-11.2	25	6.34±1.75	2.2-9.6	8	5.68±1.99	1.5-7.6	8	7.79±1.43	5.8-9.7

Note Point A: lateral of the nose; Point B: midpoint between points A and C; Point C: 1-2cm near corner of the mouth.
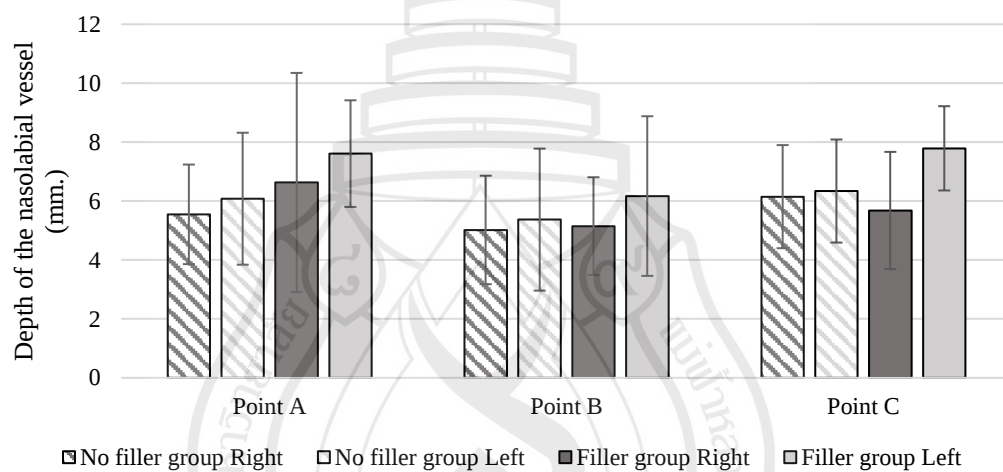
Figure 4.10 Display Bar Graph and Error Bar Showing the Depth of the Nasolabial Vessel at Points A, B, and C on the Right and Left Side, Including a History of Filler Injection
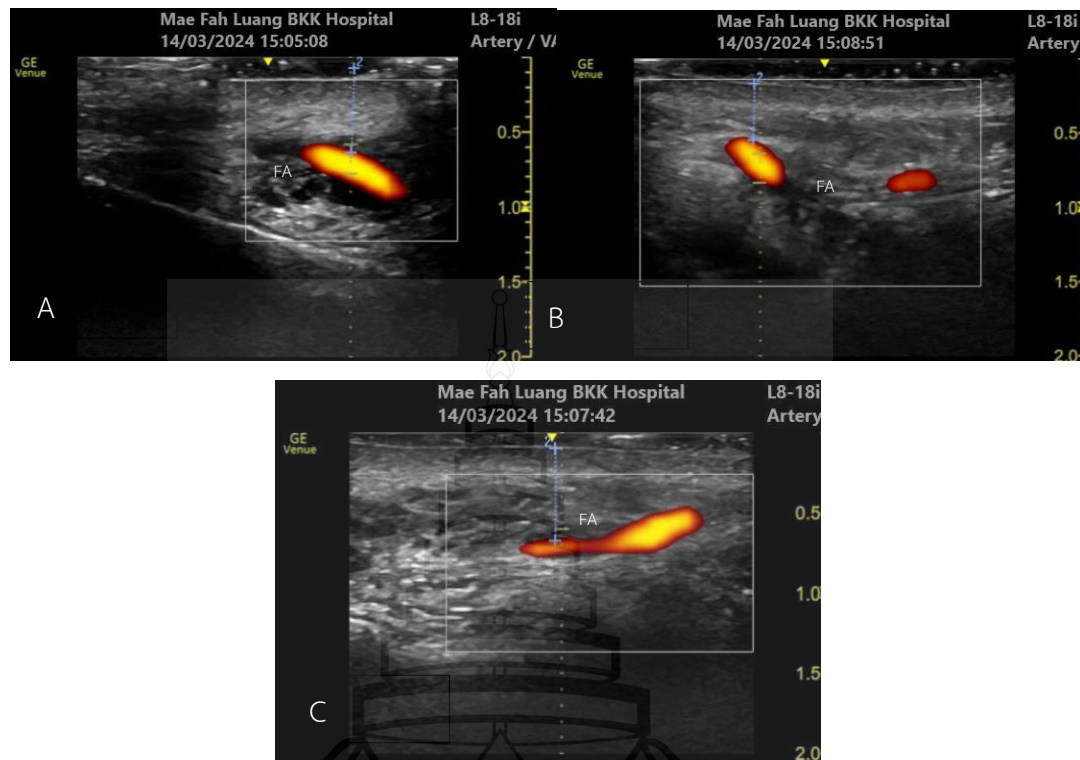
Figure 4.11 The Depth of the Artery in mm on the Right Side of NLF from each Point
A, B, and C, FA; Facial Artery

4.2.2.2 Position of facial vessel

1. Position of vessel in all subjects (n=33)

The facial artery at position A (lateral of the nose) on the right side was mainly found in the muscle layer at 34.0%, followed by the supra-periosteal layer at 30.0%, the subcutaneous layer at 24.0%, and the subdermal layer at 3.0%, respectively. On the left side, mainly found were the muscle layer at 46.0% was mainly found, followed by the supra-periosteal layer at 30.0%, the subcutaneous layer at 18.0%, and the subdermal layer at 3.0%, respectively (Table 4.6).

The facial artery at position B (midpoint between points A and C) on the right side was mainly found in the muscle layer and subcutaneous layer each at 35.5%, and the subdermal layer at 3.0%, respectively. On the left side, mainly found were the muscle layer at 34.0%, followed by the subcutaneous layer at 27.0%, and the subdermal layer at 9.0%, respectively (Table 4.6).

The facial artery at position C (1-2 cm near the corner of the mouth) on the right side was mainly found in the muscle layer at 79.0%, followed by the subcutaneous layer at 15.0%, and the subdermal layer at 3.0%, respectively. On the left side, mainly found were the muscle layer at 91.0% (Figure 4.13b), followed by the subcutaneous layer at 6.0%, and the subdermal layer at 3.0%, respectively (Table 4.6).

However, the facial artery was absent at position A on the right (Figure 4.13a) and left sides in 9.0% and 3.0% of subjects, respectively. It was absent at position B on the right and left sides in 24.0% and 30.0% of subjects, respectively. Only 3.0% of subjects were absent at position C on the right side (Table 4.6).

**Table 4.7** Position of Facial Artery in All Subjects (N=33)

| Position of facial artery (n=33)	Right, n(%)	Left, n(%)
Point A (Lateral of nose)		
Subdermal layer	1 (3.0)	1 (3.0)
Subcutaneous layer	8 (24.0)	6 (18.0)
Muscle layer	11 (34.0)	15 (46.0)
Supra-periosteal layer	10 (30.0)	10 (30.0)
Absent artery	3 (9.0)	1 (3.0)
Point B (Midpoint between points A and C)		
Subdermal layer	1 (3.0)	3 (9.0)
Subcutaneous layer	12 (35.5)	9 (27.0)
Muscle layer	12 (35.5)	11 (34.0)
Absent artery	8 (24.0)	10 (30.0)
Point C (1-2cm near corner of mouth)		
Subdermal layer	1 (3.0)	1 (3.0)
Subcutaneous layer	5 (15.0)	2 (6.0)
Muscle layer	26 (79.0)	30 (91.0)
Absent artery	1 (3.0)	0 (0.0)
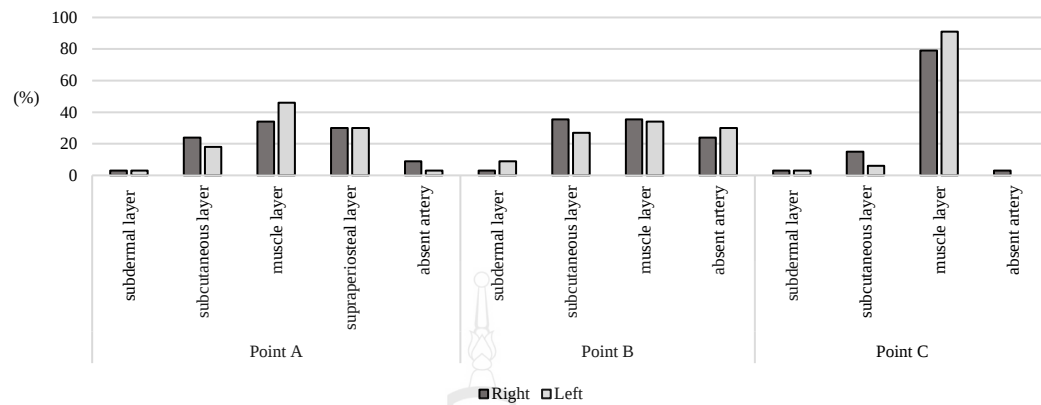
Figure 4.12 Display Bar Graph and Error Bar Showing the Depth of the Nasolabial
Vessel at Points A, B, and C on the Right and Left Side

Figure 4.13 No Angular Artery can be Detected in the Nasolabial Fold Area (Point A)
on the Right Side

Figure 4.14 Location of Facial Artery (FA) in a Muscular Layer on the Left Side NLF
(Point C; 1-2 cm Near Corner of the Mouth)
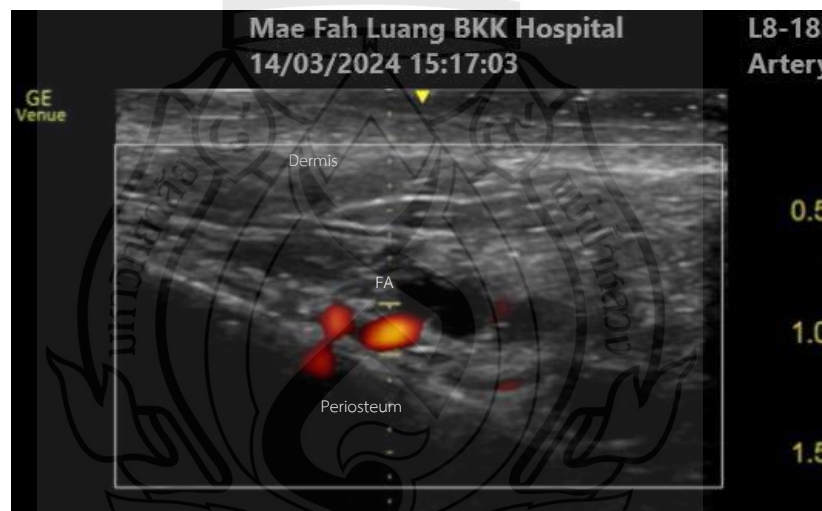
Figure 4.15 Location of the Artery (FA) in the Supra-Periosteal Layer in Left Side
NLF (Point A)

Figure 4.16 Location of Facial Artery in the Subdermal Layer of Left Side NLF (Point
B), FA; Facial Artery

2. Position of vessel in filler injection (n=8) and no filler injection
(n=25)

However, if we divided the volunteer group into two: a filler injection
group and no filler injection group, the participant with no filler usage history had a
facial artery at position A (lateral of the nose) that was mainly found in the muscle layer
and supra-periosteal layer on the right side, each at 32.0%, and on the left side, it was
mainly found in the muscle layer at 40.0%. In contrast, the participant with filler usage
history had a facial artery at position A (lateral of the nose) that was mainly found in
the muscle layer on the right side at 37.5%, and on the left side, it was mainly found in
the muscle layer at 62.5%.

The participant with no filler usage history had a facial artery at position
B (midpoint between points A and C) that was mainly found in the muscle layer and
supra-periosteal layer on the right side, each at 36.0%, and on the left side, it was mainly
found in the subcutaneous layer at 32.0%. In contrast, the participant with filler usage
history had a facial artery at position B (midpoint between points A and C) that was
mainly found in the muscle layer and subcutaneous layer on the right side each at
37.5%, and on the left side, it was mainly found in the muscle layer at 50.0%.

The participant with no filler usage history had a facial artery at position C (1-2 cm near the corner of the mouth) that was mainly found in the muscle layer on the right side at 80.0%, and on the left side, it was mainly found in the muscle layer at 88.0%. In contrast, the participant with filler usage history had a facial artery at position C (1-2 cm near the corner of the mouth) that was mainly found in the muscle layer on the right side at 75.0%, and on the left side, all of the participants found in the muscle layer.

However, the facial artery was absent at position A on the right sides in 12.0% of no filler usage history subjects and on the left sides in 12.5% of filler usage history subjects. It was absent at position B on the right and left sides in 24.0% and 32.0% of no filler usage history subjects and on the right and left sides each in 25.0% of filler usage history subjects. Only 4.0% of no filler usage history subjects were absent at position C on the right side. The descriptive statistics of the position of the facial artery at points A, B, and C are shown in Table 4.8. Display Bar graph showing the position of the facial artery at points A, B, and C on the right and left side, including a history of filler injection is shown in Figure 4.17.

Table 4.8 Position of the Facial Artery

Position of the facial artery	No filler group (n=25)		Filler group (n=8)	
	Right, n (%)	Left, n (%)	Right, n (%)	Left, n (%)
Point A				
Subdermal layer	0 (0.0)	1 (4.0)	1 (12.5)	0 (0.0)
Subcutaneous layer	6 (24.0)	6 (24.0)	2 (25.0)	0 (0.0)
Muscle layer	8 (32.0)	10 (40.0)	3 (37.5)	5 (62.5)
Supra-periosteal layer	8 (32.0)	8 (32.0)	2 (25.0)	2 (25.0)
Absent artery	3 (12.0)	0 (0.0)	0 (0.0)	1 (12.5)
Point B				
Subdermal layer	1 (4.0)	2 (8.0)	0 (0.0)	1 (12.5)
Subcutaneous layer	9 (36.0)	8 (32.0)	3 (37.5)	1 (12.5)
Muscle layer	9 (36.0)	7 (28.0)	3 (37.5)	4 (50.0)
Absent artery	6 (24.0)	8 (32.0)	2 (25.0)	2 (25.0)

Table 4.8 (continued)

Position of the facial artery	No filler group (n=25)		Filler group (n=8)	
	Right, n (%)	Left, n (%)	Right, n (%)	Left, n (%)
Point C				
Subdermal layer	1 (4.0)	1 (4.0)	1 (12.5)	0 (0.0)
Subcutaneous layer	3 (12.0)	2 (8.0)	1 (12.5)	0 (0.0)
Muscle layer	20 (80.0)	22 (88.0)	6 (75.0)	8 (100.0)
Absent artery	1 (4.0)	0 (0.0)	0 (0.0)	0 (0.0)

Note Point A: lateral of the nose; Point B: midpoint between points A and C; Point C:

1-2cm near corner of the mouth
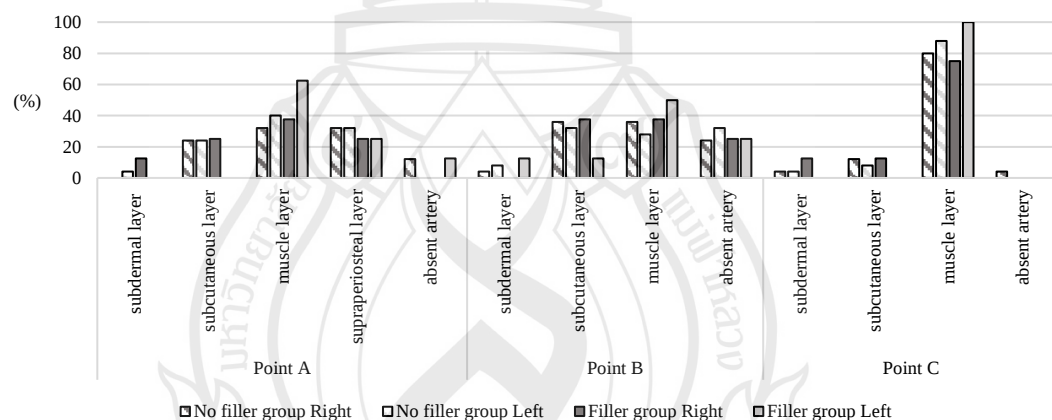
Figure 4.17 Display Bar Graph Showing the Position of the Facial Artery at Points A,

B, and C on the Right and Left Side, Including a History of Filler Injection

CHAPTER 5

DISCUSSION AND CONCLUSION

5.1 Discussion

The Nasolabial fold region is a very vulnerable area in the face, which can cause people to appear old and unapproachable. As people get older, the nasolabial folds can occur and can lead to further aggravation of depression, so correction is recommended. The nasolabial region consists of bone, muscle, fat, and skin. The facial bone offers stability and framework for the attachment of surrounding soft tissue. As we age, the bones shrink and remodel, which causes soft tissue that lies on the top to recede and change the position. The malar fat pad may descend from loss of support of bone and the weakening of the orbital and malar ligament. Moreover, the repetitive contraction of muscles and changing muscle tone led to a deepening of the folds.

However, nasolabial filler injection carries a high risk due to the complex structure and vessel anastomosis in the area. It is important to have a thorough understanding of the distribution and properties of the soft tissue at each layer in the nasolabial region, especially in terms of depth. While cadaver anatomy helps demonstrate the intricacies of the tissue, it is not precise in estimating tissue depth. To accomplish this, we can use ultrasonic exploration. The layers of the nasolabial fold that we can identify by high-frequency ultrasound are dermal thickness, subcutaneous, SMAS, and bone.

Measurement at points A to C in the no filler injection group showed that the thickness of each layer from the left and right sides was not much different. At point A, the skin thickness on both sides was 1.82±0.40 mm and 1.95±0.32 mm and the subcutaneous thickness was 3.08±0.84 mm and 2.93±0.79 mm. The SMAS thickness from the skin surface were 4.98±1.07 mm and 4.84±0.98 mm, and the bone were 9.72±1.87 mm and 10.56±1.99 mm. At point B, the skin thickness was 2.05±0.33 mm and 2.03±0.31 mm, the subcutaneous layer was 3.11±0.60 mm and 3.52±0.64 mm, the SMAS was 5.20±0.65 mm and 5.63±0.81

mm right and left respectively. At point C, the skin thickness was 1.84±0.34 mm and 1.82±0.41 mm, the subcutaneous was 3.03±0.67 mm and 3.48±0.73 mm, the SMAS was 4.92±0.83 mm and 5.04±1.24 mm right and left respectively. Current research by Salvia et al., 2023, about Ultra-High-Frequency Ultrasound as an Innovative Imaging Evaluation of Hyaluronic Acid Filler in Nasolabial Fold Region, Italy. He measured the dermal thickness of the nasolabial region at the baseline was 2.04 mm (±0.09 mm) and 2.05 mm (±0.1 mm) for right and left respectively. By comparing our study with this study, the skin thickness in our study non-filler group was not very much different from the skin thickness at baseline measured by Salvia et al. (2023).

In addition, the measurement at points A to C in the filler injection group (n=8) showed that the thickness of each layer from the right and left side of point A: the skin thickness was 1.45±0.43 mm and 1.66±0.45 mm, the subcutaneous was 2.84±0.61 mm and 3.24±0.39 mm, the SMAS was 4.48±1.11 mm and 4.85±0.56 mm, the bone was 9.8±2.39 mm and 11.76±1.89 mm. At Point B of the filler group, the skin thickness was 1.81±0.35 mm and 1.99±0.35 mm, the subcutaneous was 3.24±0.41 mm and 3.55±1.00 mm, and the SMAS was 5.03±0.57 mm and 5.45±1.12 mm. At Point C, the skin thickness was 1.63±0.33 mm and 1.71±0.27 mm, the subcutaneous was 3.43±1.08 mm and 3.93±1.21 mm and the SMAS was 4.95±1.30 mm and 5.54±1.18 mm right and left respectively. The mean of dermal thickness after filler injection by Salvia et al., 2023 was 2.28 mm (±15mm) on the right and 2.27 mm (±0.15 mm) on the left, and the dermal thickness 24 weeks after filler injection was 2.19mm (±0.14 mm) on both sides. If we compare these two studies, the dermal thickness after immediate filler injection by Salvia et al., 2023 was thicker than the filler injection group (n=8) of our study. If we compare the dermal thickness in the filler group (n=8) with the dermal thickness 24 weeks after filler injection by Salvia, there was not much difference. Moreover, if we compare the filler injection group (n=8) and no filler group (n=25), the skin thickness in the non-filler group is slightly thicker than the filler group. However, the BMI, the age, the duration of the filler injection, and the types of filler may affect the measurement.

Blood vessels represent the primary risk while receiving filler injections. Non-ischemic complications and ischemic complications such as arterial occlusion, followed by ischemia, with the necrosis of skin or vision loss, were associated with the injection of dermal filler in the nasolabial region. Lee et al. (2020), used DUS to visualize the artery anatomy position of the nasolabial fold in 80 cases of the same Korean background: detect the artery

present in the subdermal layer 13%, the subcutaneous layer 29%, the muscle layer 24%, and submuscular layer 4%, also 31% located lateral to nasolabial fold. In this investigation, we detected variances in artery position at each point A-C in the same Thai population (n=33). In point A, the depth of the angular artery was 5.84±2.37 mm and 6.42±2.22 mm, right and left respectively. We found the variation position of the angular artery in the subdermal layer 3% both right and left, the subcutaneous layer 24% and 18%, the muscular layer 34% and 46%, the supra-periosteal layer 30%, and the absent 9% and 3% in right and left respectively. At point B, the depth of the facial artery was 5.05±1.76 mm and 5.58±2.45 mm right and left. The position of the artery in the subdermal layer was 3% and 9%, the subcutaneous layer 35.5% and 27%, the muscular layer 35.5% and 34%, and the absent 24% and 30% left and right side respectively. At point C, the depth of the artery was 6.03±1.79 mm and 6.69±1.77 mm right and left. The position of the artery in the subdermal layer was 3% on both sides, the subcutaneous layer was 15% and 6%, the muscular layer was 79% and 91% on the right and left respectively, and the absent artery was 3% on the right side of the nasolabial fold. The absence of the artery means the artery could not be detected near the nasolabial lines or on the line. However, especially point B, we confirm by moving the probe to the lateral and medial side and we count the presence of the artery only on the line of the nasolabial folds.
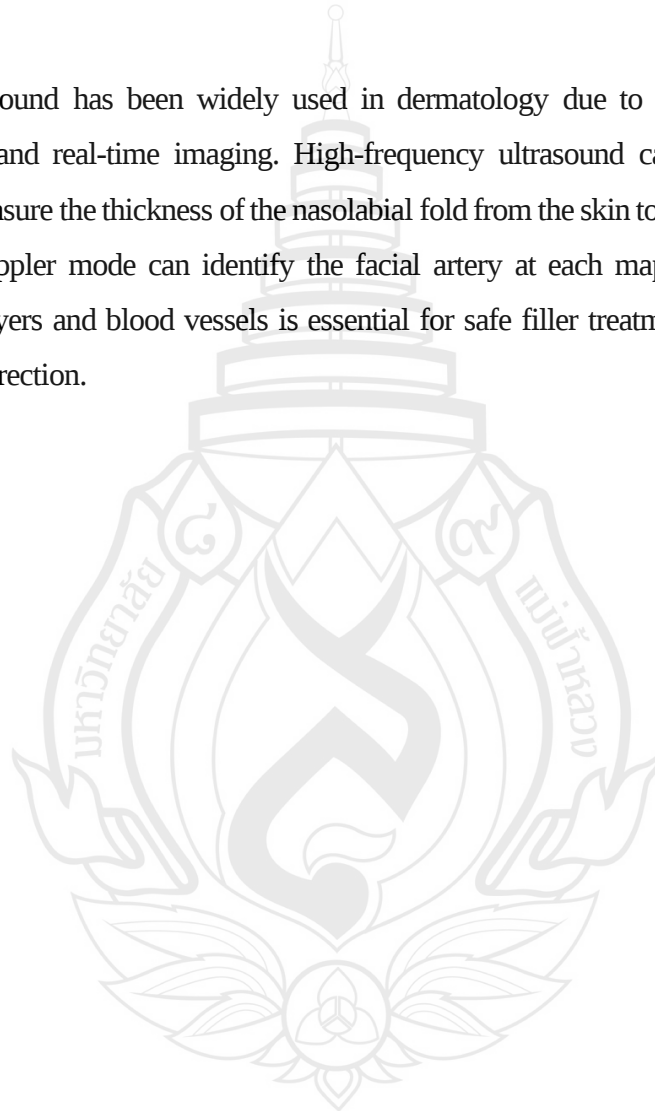
Over several decades, there has been constant improvement and expansion in the use of ultrasound for medical diagnosis. High-frequency ultrasound enables the real-time detection of tissue motion and blood vessel dynamics. Lately, numerous studies have recommended the use of Ultrasound for detecting the facial artery and the use of guided filler injection or lipo-filling. In our study, we concentrated on the real-time analysis of the position and depth of the facial artery and soft tissue structures. Unfortunately, we could not distinguish every anatomical layer of the nasolabial folds, particularly the separation of the muscle layer from the SMAS layer. Additionally, the depth of vessels below the skin, as measured by ultrasound, could vary if excessive pressure was applied with the probe. Furthermore, the relationship between the nasolabial folds and the anatomic layers, depth, and position of the artery was the main emphasis of this investigation rather than the course.
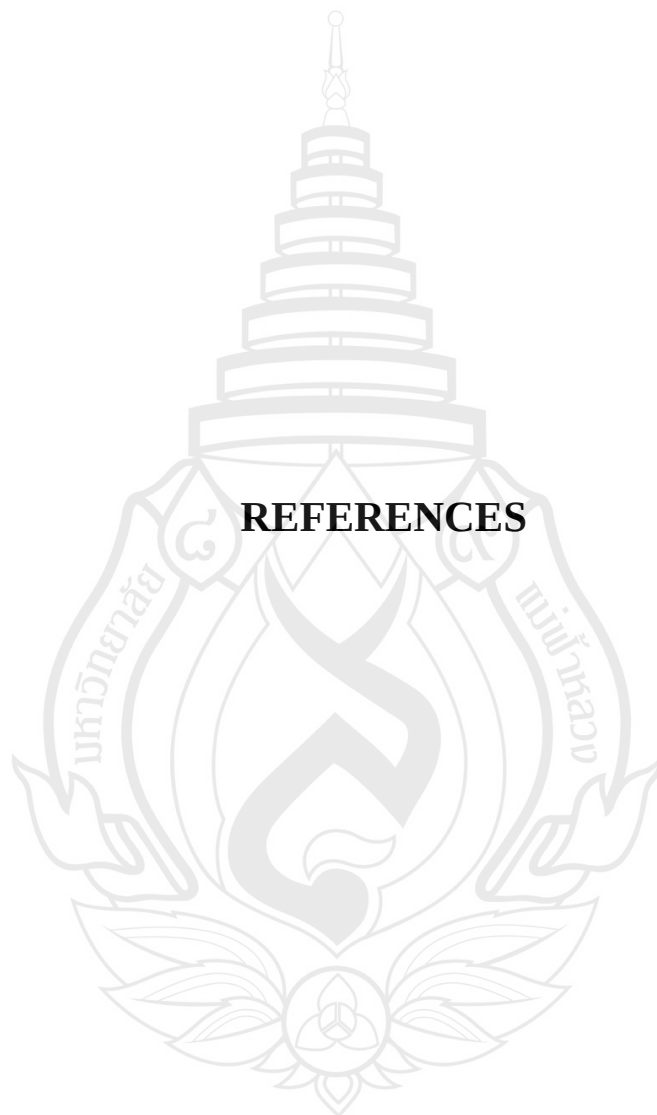
This study has some limitations. First, high-frequency ultrasound requires a significant learning curve, making it less accessible to practitioners without specialized training. Second, high-frequency ultrasound is limited in its ability to distinguish every layer within the nasolabial folds. Future research should aim to delineate the specific arrangement

of facial soft tissue layers, particularly in the nasolabial fold region. Additionally, studies should investigate the pathway of the facial artery to develop definitive protocols for the use of ultrasound in visualizing facial soft tissue structures.

5.2 Conclusions

Ultrasound has been widely used in dermatology due to its advantages of non-invasiveness and real-time imaging. High-frequency ultrasound can visualize facial soft tissue and measure the thickness of the nasolabial fold from the skin to the bone. Additionally, its power Doppler mode can identify the facial artery at each mapped point. Identifying anatomical layers and blood vessels is essential for safe filler treatments and lipo-filling in nasolabial correction.

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APPENDICES

APPENDIX A

ETHICAL APPROVAL DOCUMENT

The Mae Fah Luang University Ethics Committee on Human Research

333 Moo 1, Thasud, Muang, ChiangRai 57100

Tel: (053) 917-170 to 71, (053) 916-551   Fax: (053) 917-170   E-mail: rec.human@mfu.ac.th

CERTIFICATE OF APPROVAL

COA: 4/2024   Protocol No: EC 23273-20

Title: The Anatomy study of nasolabial fold region Based on High-frequency ultrasound investigation in Thai subjects

Principal investigator: Ms. Sorachana Thea

School: Anti Aging and Regenerative Medicine

Funding support: Personal Budget

Approval:

1) Research protocol   Version 2 Date January 29, 2024

2) Information sheet and informed consent documents   Version 2 Date January 29, 2024

3) Case Record Form   Version 1 Date December 25, 2023

4) Research participant recruitment information   Version 2 Date January 29, 2024

5) Principal investigator and Co-investigators

- Ms. Sorachana Thea   - Chantawat Kasemnet, M.D.

- Sirintip Chaichalotornkul, M.D., Ph.D.   - Asst. Prof. Tawee Saiwichai, Ph.D.

The aforementioned documents have been reviewed and approved by the Mae Fah Luang University Ethics Committee on Human Research in compliance with international guidelines such as Declaration of Helsinki, the Belmont Report, CIOMS Guidelines and the International Conference on Harmonization of Technical Requirements for Registration of Pharmaceuticals for Human Use - Good Clinical Practice (ICH GCP)

Date of Approval: February 5, 2024

Date of Expiration: February 4, 2025

Frequency of Continuing Review: 1 year

(Assoc. Prof., Maj. Gen. Sangkae Chamnanvanakij, M.D.)

Chairperson of the Mae Fah Luang Ethics Committee on Human Research

AL 02_1/2022 Certificate of Approval   หน้า 3 จาก 4

The Mae Fah Luang University Ethics Committee on Human Research
333 Moo 1, Thasud, Muang, ChiangRai 57100
Tel: (053) 917-170 to 71, (053) 916-551   Fax: (053) 917-170   E-mail: rec.human@mfu.ac.th

ผู้วิจัยที่โครงร่างการวิจัยผ่านการรับรองจากคณะกรรมการจริยธรรมการวิจัยในมนุษย์ มหาวิทยาลัยแม่ฟ้าหลวง
ต้องปฏิบัติดังต่อไปนี้

(1) ดำเนินการวิจัยตามที่ระบุในโครงร่างการวิจัยที่ได้รับการรับรองอย่างเคร่งครัด

(2) ใช้เอกสารข้อมูลและขอความยินยอมเข้าร่วมการวิจัย/แบบสอบถาม/แบบบันทึกข้อมูล ที่มีตราประทับ
ของคณะกรรมการจริยธรรมการวิจัยในมนุษย์ มหาวิทยาลัยแม่ฟ้าหลวง เท่านั้น

(3) ผู้วิจัยต้องส่งแบบรายงานความก้าวหน้าของการวิจัย และขอต่ออายุการรับรองโครงการวิจัย (AP 05/2022)
ตามระยะเวลาที่กำหนดโดยคณะกรรมการ <u>ภายใน 30 วัน ก่อนหมดอายุการรับรองครั้งล่าสุด</u> ในกรณีที่การเก็บ
ข้อมูลจากอาสาสมัครยังไม่แล้วเสร็จ ผู้วิจัยต้องส่งรายงานความก้าวหน้าของการวิจัย พร้อมทั้งขอต่ออายุ
การรับรอง

(4) เมื่อมีการแก้ไขเพิ่มเติมโครงร่างการวิจัย ผู้วิจัยต้องส่งแบบรายงานส่วนแก้ไขเพิ่มเติมโครงร่างการวิจัย
(AP 06/2022) และโครงร่างการวิจัยที่มีการแก้ไขเพิ่มเติม เพื่อแจ้งให้คณะกรรมการพิจารณารับรองก่อน
ดำเนินการตามที่ได้แก้ไขเพิ่มเติม ยกเว้นในกรณีที่การแก้ไขเพิ่มเติมนั้นกระทำเพื่อความปลอดภัย
ของอาสาสมัคร

(5) เมื่อมีเหตุการณ์ไม่พึงประสงค์ชนิดร้ายแรง เกิดขึ้นกับอาสาสมัครที่เข้าร่วมในการวิจัยที่ผู้วิจัยรับผิดชอบ ผู้วิจัย
ต้องส่งแบบรายงานเหตุการณ์ไม่พึงประสงค์ชนิดร้ายแรง ในสถาบัน (AP 07/2022) หรือแบบรายงานตามที่
ผู้สนับสนุนการวิจัยกำหนด

(6) เมื่อมีการเบี่ยงเบนจากโครงการวิจัยที่ผ่านการรับรอง หรือไม่ปฏิบัติตามข้อกำหนด ผู้วิจัยต้องส่งแบบรายงาน
การเบี่ยงเบนจากโครงการวิจัยที่ผ่านการรับรอง หรือการไม่ปฏิบัติตามข้อกำหนด (AP 08/2022)

(7) เมื่อการวิจัยเสร็จสิ้น ผู้วิจัยต้องส่งแบบรายงานสรุปผลการวิจัย (AP 09/2022)

(8) เมื่อมีการยุติโครงการวิจัยก่อนกำหนด ผู้วิจัยต้องส่งแบบรายงานการยุติโครงการวิจัยก่อนกำหนด
(AP 10/2022)

<u>หมายเหตุ</u> สามารถ Download แบบรายงานต่าง ๆ ได้ที่ https://ec.mfu.ac.th

ข้าพเจ้าในฐานะ ผู้วิจัย ยินยอมที่จะปฏิบัติตามข้อกำหนดดังกล่าว

....
(Ms. Sorachana Thea)
วันที่ 06/02/2024

AL 02_1/2022 Certificate of Approval   หน้า 2 จาก 4

APPENDIX B

INFORMATION CONSENT

เอกสารข้อมูลและขอความยินยอมเข้าร่วมการวิจัย

ชื่อโครงการวิจัย : การศึกษากายวิภาคของร่องแก้มด้วยเครื่องอัลตร้าซาวด์ในคนไทย

ผู้วิจัยหลัก : Sorachana Thea

สังกัด : School of anti-aging and regenerative medicine

อาจารย์ที่ปรึกษา : Sirintip Chaichalotornkul, M.D., Ph.D.

1. บทนำส่วนต้น สรุปสาระหลักของโครงการวิจัย

ความชราของใบหน้า เกิดจากความเปลี่ยนแปลงในชั้นกระดูก กล้ามเนื้อ ชั้นไขมัน และ ผิวหนัง ความเปลี่ยนแปลงนี้ทำให้เกิดผลเสียต่ออารมณ์ จิตใจ และสังคม เนื่องจาก ส่งผลต่อการรับรู้ ตนเองและความสัมพันธ์ระหว่างบุคคล การแก้ไขโดยการเติมเต็มใบหน้า บริเวณส่วนกลางของใบหน้า และการเติมเต็มร่องแก้ม โดยใช้สารเติมเต็ม(ฟิลเลอร์) เป็นวิธีที่ได้รับความนิยมบ่อยที่สุด อย่างไรก็ ตามหลอดเลือดแดงที่อยู่บนใบหน้าและความเชื่อมโยงต่อกันทำให้บริเวณร่องแก้มเป็น บริเวณที่มี ความเสี่ยง ต่อการฉีดฟิลเลอร์และการทำศัลยกรรม ความก้าวหน้าในขณะนี้ของการใช้ ภาพอัลตร้า ซาวด์ ทำให้เกิดการมองเห็นในขณะที่ทำจริง สามารถวัดความลึกของ เส้นเลือดแดงที่ร่องแก้มและ ตำแหน่งได้ การศึกษาวิจัยนี้ มีจุดประสงค์เพื่อศึกษากายวิภาคศาสตร์บริเวณร่องแก้ม ของ โดยใช้ คลื่นอัลตร้าซาวด์ความถี่สูงในคนไทย การศึกษานี้เป็นไปด้วยความสมัครใจ อาสาสมัครจะได้รับการ ตรวจวัดอัลตร้าซาวด์ความถี่สูง 1 ครั้ง ที่บริเวณร่องแก้มทั้งสองข้าง โดยไม่ต้องนัดติดตาม ความไม่ สะดวกที่อาจเกิดขึ้นได้มีเพียงแค่การใช้เจลทาบริเวณที่จะทำอัลตร้าซาวด์ซึ่งไม่เป็นอันตราย อาสาสมัครสุขภาพดีชายและหญิง 33คน ทั้งคนที่เคยได้รับการฉีดฟิลเลอร์ร่องแก้ม และไม่เคยฉีดฟิล เลอร์ร่องแก้มจะได้รับคัดเลือก อาสาสมัครได้รับคัดเลือก จะได้ทราบขั้นตอนวิธีการทำงานวิจัย ลง ลายมือชื่อเป็นลายลักษณ์อักษร ผู้วิจัยจะอธิบายจุดประสงค์ของงานวิจัย ในงานวิจัยนี้ จะมีการ ถ่ายภาพของอาสาสมัครเพื่อเก็บข้อมูล การวิจัยจะทำกับอาสาสมัครทีละคนในห้องปิดโดยผู้วิจัย จะมี การวัดคะแนนความลึกของบริเวณร่องแก้มโดยผู้วิจัย ผลของการวิจัยนี้จะเป็นพื้นฐานสำคัญเพื่อเพิ่ม ความปลอดภัยและช่วยเพิ่มประสิทธิภาพในการทำหัตถการด้านผิวหนังและความงามบริเวณร่องแก้ม

ยิ่งไปกว่านั้นผลของงานวิจัยจะช่วยทำให้เกิดการเรียนรู้สิ่งใหม่ เป็นแหล่งความรู้ให้แก่แพทย์ และทำ
ให้สามารถนำเครื่องมืออัลตร้าซาวด์นี้มาใช้ให้เกิดประโยชน์ต่อการศึกษาบริเวณร่องแก้มต่อไป

2. ข้อมูลระบุว่าเป็นการวิจัยและความเป็นอิสระในการตัดสินใจเข้าร่วมการวิจัย

ท่านได้รับเชิญให้เข้าร่วมการวิจัย โปรดใช้เวลาในการอ่านเอกสารฉบับนี้ ซึ่งจะช่วยให้ท่าน
รับทราบสิ่งต่าง ๆ ที่ท่านจะมีส่วนร่วมในการวิจัยนี้ การตัดสินใจเข้าร่วมการวิจัยนี้ขึ้นอยู่กับความ
สมัครใจของงาน หากท่านไม่สมัครใจเข้าร่วมการวิจัย จะไม่มีผลใด ๆ ต่อการดูแลรักษาหรือสิทธิที่ท่าน
พึงมี

การเข้าร่วมการวิจัยนี้ขึ้นอยู่กับความสมัครใจ

- ■ ท่านสามารถตัดสินใจได้อย่างอิสระว่าจะเข้าร่วมหรือไม่เข้าร่วมการวิจัยนี้
- ■ ท่านสามารถปรึกษาครอบครัวหรือแพทย์ผู้รักษาก่อนตัดสินใจ และสามารถซักถามข้อสงสัย
  เกี่ยวกับโครงการวิจัยได้ ซึ่งผู้วิจัยจะอธิบายเพิ่มเติมแก่ท่านและตอบข้อซักถามจนท่าน
  เข้าใจ
- ■ หากท่านสมัครใจเข้าร่วมการวิจัยนี้แล้ว ท่านยังคงสามารถถอนตัวออกจากการวิจัยได้
  ทุกเมื่อ

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3. เหตุผลและความสำคัญของการวิจัย

ร่องแก้มเป็นสัญญาณที่เด่นชัดที่สุดของความชราบนใบหน้า แม้ว่ามันไม่ได้ก่อให้เกิดอันตราย
ต่อสุขภาพ แต่สิ่งนี้ทำให้เกิดการกระจายเนื้อเยื่ออ่อนไม่สมดุล สามารถนำไปสู่ผลกระทบทางอารมณ์
จิตใจและสังคมเพราะมันสามารถทำให้เกิดการเปลี่ยนแปลงของการรับรู้ตนเองและอาจส่งผลต่อ
ความสัมพันธ์ระหว่างบุคคลของแต่ละคน ดังนั้นขั้นตอนการทำหัตถการด้านความงามหลายอย่างจึง
ถูกพัฒนาขึ้น เช่น การฉีดโบทูลินั่มท็อกซิน การร้อยไหม ไฮฟู (HIFU) การปลูกถ่ายไขมัน และการฉีด
ฟิลเลอร์สำหรับการแก้ไขร่องแก้ม อย่างไรก็ตาม เนื่องจากโครงสร้างทางกายวิภาคที่ซับซ้อนของ
ใบหน้า (บริเวณร่องแก้ม) และ การเชื่อมต่อกันของเส้นเลือด วิธีที่ช่วยในการมองเห็นโครงสร้างใบหน้า
จึงถูกคิดค้นขึ้น อัลตร้าซาวด์หรือ โดยเฉพาะอย่างยิ่งคลื่นเสียงความถี่สูง มักใช้ในโรคผิวหนังเพื่อให้
เห็นภาพโครงสร้างใบหน้าและตำแหน่งของหลอดเลือด นอกจากนี้มันยังให้ภาพแบบเรียลไทม์ของ
รายละเอียดทางกายวิภาค เช่น อนุภาคฟิลเลอร์ ความลึกของหลอดเลือดแดงใบหน้า และการใช้อัลต
ร้าซาวด์เพื่อจัดการกับภาวะแทรกซ้อน (ก้อน, อาการบวม, ก้อนเนื้อเยื่ออักเสบ ฯลฯ) การศึกษา
ล่าสุดได้จัดทำเอกสารคู่มืออัลตร้าซาวด์สำหรับการประเมินก่อนและหลังการฉีดฟิลเลอร์ อย่างไรก็
ตามยังไม่มีการศึกษาเกี่ยวกับโครงสร้างบริเวณร่องแก้มขั้นพื้นฐาน ความลึกและตำแหน่งของหลอด
เลือดแดงในบริเวณร่องแก้มในประชากรไทยสำหรับผู้ที่ได้รับการฉีดฟิลเลอร์และไม่เคยได้รับการฉีด

ฟิลเลอร์มาก่อนด้วยเครื่องอัลตร้าซาวด์ความถี่สูง ดังนั้นการประเมินเครื่องอัลตร้าซาวด์ของหลอด
เลือดแดงและโครงสร้างของบริเวณร่องแก้มจะได้รับการศึกษา

4. คุณสมบัติของผู้ที่สามารถเข้าร่วมการวิจัย และจำนวนผู้เข้าร่วมการวิจัย

การวิจัยนี้จะคัดเลือกอาสาสมัครชายและหญิงอายุระหว่าง 25-50 ปี จำนวน 33 คน ที่มี
คะแนนความรุนแรงของริ้วรอย (WSRS) 1, 2, 3, 4, 5 ตามลำดับ

5. วัตถุประสงค์ของการวิจัย

โครงการวิจัยนี้มีวัตถุประสงค์เพื่อศึกษาโครงสร้างของร่องแก้มขั้นพื้นฐาน (ชั้นผิวหนัง
ชั้นไขมันกล้ามเนื้อ) และการเปลี่ยนแปลงของหลอดเลือดแดงในร่องแก้มโดยใช้อัลตร้าซาวด์ความถี่สูง
คะแนนอัตราความรุนแรงของริ้วรอย (WSRS) ของร่องแก้มจะได้รับการประเมินก่อนการสแกน
อัลตร้าซาวด์

6. รูปแบบการวิจัย

เป็นการศึกษาแบบตัดขวางเชิงสังเกตซึ่งเป็นการตรวจเพียงครั้งเดียวโดยอัลตร้าซาวด์ความถี่
สูงในกลุ่มที่ไม่เคยได้รับฟิลเลอร์เพื่อระบุความลึกและตำแหน่งของหลอดเลือดแดงและโครงสร้างของ
ร่องแก้ม การวัดผลลัพธ์รวมถึงความลึกและตำแหน่งของหลอดเลือดแดงและความหนาของร่องแก้ม
เช่น ชั้นผิวหนัง ชั้นไขมันและกล้ามเนื้อ

7. ขั้นตอนการวิจัยและระยะเวลาที่เข้าร่วมการวิจัย

ผู้วิจัยจะอธิบายวัตถุประสงค์ของการวิจัยอย่างละเอียด ขั้นตอนโดยละเอียดและความเสี่ยงที่
คาดการณ์ไว้และประโยชน์ของการศึกษา เมื่ออาสาสมัครผ่านการคัดเลือกเพื่อเข้าร่วมการศึกษาวิจัย
อาสาสมัครจะต้องกรอกแบบฟอร์มและชื่อในความยินยอมที่ได้รับแจ้ง ประวัติทั่วไปของอาสาสมัคร
การรักษาพยาบาลก่อนหน้านี้และประวัติที่เกี่ยวข้องกับการศึกษาในครั้งนี้จะถูกบันทึกไว้ ผู้เข้าร่วมจะ
ได้รับการทำอัลตร้าซาวด์ความถี่สูงเพียงครั้งเดียวเพื่อทำแผนผังหลอดเลือดและเพื่อให้เห็นภาพ
โครงสร้างบริเวณร่องแก้ม

8. ความเสี่ยงและความไม่สะดวกสบายจากการเข้าร่วมการวิจัย

อาสาสมัครที่เข้าร่วมโครงการวิจัยนี้อาจต้องสละเวลามาเข้าร่วมวิจัย ซึ่งใช้เวลาประมาณ
10 – 15 นาที หากมีความรู้สึกไม่สบายหรือมีข้อสงสัยใด ๆ สามารถถามคำถามผู้วิจัยได้ตลอดเวลา
ทั้งนี้เนื่องจากอาสาสมัครจะได้รับการสแกนอัลตร้าซาวด์ความถี่สูงพร้อมการประเมินและ
แบบสอบถามโดยผู้วิจัย อาสาสมัครทุกคนจะได้รับค่าเดินทางในมาร่วมในการวิจัย อาสาสมัครและ

สามารถตัดสินใจได้อย่างอิสระว่าจะเข้าร่วมหรือไม่เข้าร่วมในการวิจัยนี้ หากคุณตัดสินใจที่จะเข้าร่วม
ในการวิจัยนี้คุณยังสามารถถอนตัวจากการวิจัยได้ตลอดเวลา นอกจากนี้ โครงการวิจัยจะถ่ายภาพ
ใบหน้าของอาสาสมัครและผลการตรวจจากเครื่องอัลตร้าซาวด์เพื่อเก็บข้อมูล แต่จะมีการป้องกันการ
เปิดเผยข้อมูลส่วนบุคคลและจะไม่จัดเก็บข้อมูลที่สามารถระบุตัวบุคคลได้ โดยข้อมูลและภาพถ่ายของ
อาสาสมัครจะถูกเก็บไว้เป็นเวลา 5 ปี หลังจากนั้นจะถูกทำลายทิ้งทั้งหมด การศึกษาจะดำเนินการกับ
อาสาสมัครครั้งละหนึ่งคนและภาพถ่ายจะถูกเก็บไว้เป็นความลับ

9. ประโยชน์ที่คาดว่าจะเกิดขึ้นจากการเข้าร่วมการวิจัย

ประโยชน์โดยตรงต่อผู้เข้าร่วมการวิจัยคือการได้รับการสแกนอัลตร้าซาวด์ความถี่สูงทั้งสอง
ด้านของร่องแก้ม เป็นการใช้เทคนิคที่ไม่รุกรานที่มีประโยชน์เพื่อให้เห็นภาพโครงสร้างเนื้อเยื่อและเพื่อ
ความปลอดภัยโครงการวิจัยนี้อาจให้ความปลอดภัยแก่ผู้คนมากขึ้นและเพิ่มความมั่นใจให้กับขั้นตอน
การทำหัตถการด้านความงาม ตั้งแต่การมองเห็นโครงสร้างใบหน้า (บริเวณร่องแก้ม) เพื่อลดความ
เสี่ยงรวมถึงการรักษาภาวะแทรกซ้อนจากการฉีดฟิลเลอร์ ผลการวิจัยนี้จะเป็นประโยชน์ในข้อมูลทาง
การแพทย์และงานวิชาการและสามารถใช้เป็นข้อมูลสำหรับการประเมินในอนาคตและแนวทางในการ
ลดอันตรายในการปฏิบัติทางการแพทย์นอกจากนี้ผลการวิจัยนี้ยังมีแผนที่จะเผยแพร่เพื่อเป็น
ประโยชน์ในการเผยแพร่ความรู้ที่เป็นประโยชน์ต่อวงการแพทย์ต่อไป

10. แนวทางการจัดการเมื่อมีสถานการณ์ที่อาจเกิดขึ้นระหว่างการวิจัย

สถานการณ์	แนวทางการปฏิบัติ
▪ หากท่านถอนตัวระหว่างการวิจัย	คุณไม่ได้เข้าร่วมในการศึกษาอีกต่อไป
▪ หากมีข้อมูลใหม่ที่เกี่ยวข้องกับการวิจัยหรือความปลอดภัยของท่าน	การวิจัยจะแจ้งให้คุณทราบอย่างรวดเร็วและคุณสามารถตัดสินใจได้ว่าคุณจะเข้าร่วมในการวิจัยนี้ต่อไปหรือไม่
▪ หากการเข้าร่วมในการวิจัยนี้ถูกยกเลิกจะถูกยกเลิกเมื่อโครงการวิจัยไม่เป็นไปตามเกณฑ์ที่เหมาะสม	นักวิจัยจะแจ้งให้คุณทราบโดยเร็วที่สุดและจะมีการชดเชยสำหรับค่าเสียเวลาสำหรับอาสาสมัครทุกคน

11. ประโยชน์หรือสิ่งที่ผู้เข้าร่วมการวิจัยอาจได้รับ หลังเสร็จสิ้นการวิจัย

หลังจากเสร็จสิ้นการวิจัยผู้เข้าร่วมการวิจัยจะสามารถทราบความลึกและตำแหน่งของหลอด
เลือดแดงในบริเวณร่องแก้มรวมถึงโครงสร้างของร่องแก้ม ผลสรุปของการวิจัยจะช่วยยืนยันความรู้

เกี่ยวกับคู่มือเครื่องอัลตร้าซาวด์สำหรับการประเมินเพื่อลดความเสี่ยงของภาวะแทรกซ้อนของฟิล
เลอร์บริเวณร่องแก้ม

12. การรักษาความลับของข้อมูลและข้อจำกัดในการรักษาความลับของข้อมูล

การบันทึกข้อมูลในโครงการวิจัยนี้จะบันทึกข้อมูลพื้นฐานสำหรับการจัดการอาสาสมัคร และ
ถ่ายภาพใบหน้าของอาสาสมัครเพื่อรวบรวมข้อมูล จะมีการป้องกันการเปิดเผยความลับและจะไม่
รวบรวมข้อมูลที่สามารถระบุตัวบุคคลได้ การปกปิดความลับของอาสาสมัครและรักษาความลับของ
ข้อมูลการวิจัยโดยทำการศึกษากับอาสาสมัครทีละหนึ่งคน ในห้องปิดควบคุมโดยแพทย์วิจัยเท่านั้น
ภาพถ่ายจะถูกเก็บรักษาไว้เป็นความลับเข้าถึงได้เฉพาะนักวิจัยและนำเสนอผลการศึกษาโดยไม่มี
ข้อมูลที่เชื่อมโยงกับผู้เข้าร่วมการวิจัยอย่างไรก็ตาม อาจมีบุคคลบางกลุ่มที่ขอเข้าดูข้อมูลส่วนบุคคล
ของท่านได้ ได้แก่ คณะกรรมการจริยธรรมการวิจัยในมนุษย์ ผู้ประสานงานวิจัย ผู้กำกับดูแลการวิจัย
และเจ้าหน้าที่จากสถาบันหรือองค์กรของรัฐที่มีหน้าที่ตรวจสอบ เพื่อตรวจสอบความถูกต้องของ
ข้อมูลและขั้นตอนการวิจัย

13. ค่าตอบแทนการเข้าร่วมในการวิจัย

ค่าตอบแทนอาสาสมัครสำหรับการเดินทางในการเข้าร่วมวิจัยเป็นจำนวนเงิน 200 บาท

14. ค่าใช้จ่ายที่ผู้เข้าร่วมการวิจัยต้องรับผิดชอบ

ค่าใช้จ่ายที่ผู้เข้าร่วมการวิจัยไม่ต้องรับผิดชอบ ได้แก่ ค่าใช้จ่ายของอุปกรณ์สำหรับการตรวจ
และการทำหัตถการและการประเมินผลในการวิจัยเนื่องจากการสนับสนุนจากนักวิจัยหรือผู้ให้ทุนวิจัย

15. แนวทางการดูแลรักษาและจ่ายค่าชดเชย กรณีที่ผู้เข้าร่วมการวิจัยได้รับอันตรายหรือ
ผลกระทบจากการเข้าร่วมการวิจัย

แม้ว่าการประเมินโดยเครื่องอัลตร้าซาวด์นี้จะไม่เป็นอันตรายต่อผู้เข้าร่วม แต่ในกรณีที่
ผู้เข้าร่วมการวิจัยได้รับอันตรายหรือได้รับผลกระทบจากการวิจัยจากการศึกษานี้ ผู้วิจัยจะจัดทำแนว
ทางการดูแลขั้นพื้นฐานและให้การดูแลที่รับผิดชอบค่าใช้จ่ายทั้งหมดสำหรับการรักษาพยาบาลและ
การฟื้นฟูสมรรถภาพ โดยค่ารักษาได้รับการสนับสนุนจากนักวิจัยหรือผู้ให้ทุนวิจัย

16. บุคคลที่สามารถติดต่อได้ กรณีที่มีปัญหาหรือข้อสงสัย

หากท่านมีข้อสงสัยเกี่ยวกับการวิจัยหรือความปลอดภัยระหว่างเข้าร่วมการวิจัย ท่านสามารถ
สอบถามผู้วิจัยได้โดยตรง Dr. Rachana, หมายเลขโทรศัพท์ 0927542142, อาจารย์ Sirintip
Chaichalotornkul, หมายเลขโทรศัพท์ 086 517 2017

หากท่านมีข้อสงสัยเกี่ยวกับสิทธิของท่าน ท่านสามารถติดต่อสอบถามได้ที่ คณะกรรมการจริยธรรมการวิจัยในมนุษย์ มหาวิทยาลัยแม่ฟ้าหลวง อาคารบริการวิชาการ (AS) ชั้น 4 มหาวิทยาลัยแม่ฟ้าหลวง โทรศัพท์ 053-917-170 ถึง 71 และ 053-916-551 โทรสาร 053-917-170 หรืออีเมล rec.human@mfu.ac.th เพื่อให้มั่นใจว่า สิทธิ ความปลอดภัย และความเป็นอยู่ที่ดีของท่าน ได้รับความคุ้มครองตามมาตรฐานจริยธรรมการวิจัยในมนุษย์-ระดับสากล

หนังสือแสดงความยินยอมเข้าร่วมการวิจัย

ข้าพเจ้า _____ ตัดสินใจเข้าร่วมการวิจัยเรื่อง "The anatomy study of Nasolabial fold region based on high-frequency ultrasound investigation in Thai subjects" ซึ่งข้าพเจ้าได้รับข้อมูลและคำอธิบายเกี่ยวกับการวิจัยนี้แล้ว และได้มีโอกาสซักถามและได้รับคำตอบเป็นที่พอใจแล้ว ข้าพเจ้ามีเวลาเพียงพอในการอ่านและทำความเข้าใจข้อมูลในเอกสารให้ข้อมูลสำหรับผู้เข้าร่วมการวิจัยอย่างถี่ถ้วน และได้รับเวลาเพียงพอในการตัดสินใจว่าจะเข้าร่วมการวิจัยนี้

ข้าพเจ้ารับทราบว่าข้าพเจ้าสามารถปฏิเสธการเข้าร่วมการวิจัยนี้ได้โดยอิสระ และระหว่างการเข้าร่วมการวิจัย ข้าพเจ้ายังสามารถถอนตัวออกจากการวิจัยได้ทุกเมื่อ โดยไม่ส่งผลกระทบต่อการดูแลรักษา หรือสิทธิที่ข้าพเจ้าพึงมีโดยการลงนามนี้ ข้าพเจ้าไม่ได้สละสิทธิใดๆ ที่ข้าพเจ้าพึงมีตามกฎหมาย และหลังจากลงนามแล้ว ข้าพเจ้าจะได้รับเอกสารข้อมูลและขอความยินยอมไว้จำนวน 1 ชุด

ลายมือชื่อผู้เข้าร่วมการวิจัย _____ วัน-เดือน-ปี _____

(_____)

.... (กรณีที่ผู้เข้าร่วมการวิจัยอ่านหนังสือไม่ออกแต่ฟังเข้าใจ) ....

ข้าพเจ้าไม่สามารถอ่านหนังสือได้ แต่ผู้วิจัยได้อ่านข้อความในเอกสารข้อมูลและขอความยินยอมนี้ให้แก่ข้าพเจ้าฟังจนเข้าใจดีแล้ว ข้าพเจ้าจึงลงนามหรือพิมพ์ลายนิ้วมือของข้าพเจ้าในหนังสือนี้ด้วยความสมัครใจ

ลงนาม/พิมพ์ลายนิ้วมือผู้เข้าร่วมการวิจัย [_____] วัน-เดือน-ปี _____

(_____)

ลายมือชื่อผู้ขอความยินยอม _____ วัน-เดือน-ปี _____

(_____)

คำรับรองของพยานผู้ไม่มีส่วนได้เสียกับการวิจัย (กรณีที่ผู้เข้าร่วมการวิจัยอ่านหนังสือไม่ออกแต่ฟัง
เข้าใจ)

      ข้าพเจ้าได้อยู่ร่วมในกระบวนการขอความยินยอมและยืนยันว่า ผู้ขอความยินยอมได้อ่าน/
อธิบายเอกสารข้อมูลให้แก่ _____ ซึ่งผู้มีชื่อข้างต้นมีโอกาสซักถามข้อ
สงสัยต่าง ๆ และได้ให้ความยินยอมเข้าร่วมการวิจัยโดยอิสระ หลังจากรับทราบข้อมูลที่มีอยู่ตรงตามที่
ปรากฏในเอกสารนี้แล้ว

ลายมือชื่อพยาน _____ วัน-เดือน-ปี _____
              (_____)

      กรณี อาสาสมัครที่เป็นเด็ก อายุน้อยกว่า 18 ปี หรือเป็นบุคคลที่มีปัญหาทางจิตหรือ
สติปัญญา ต้องได้รับการปกป้องคุ้มครองเป็นพิเศษ

      ข้าพเจ้าในฐานะ _____ กับผู้เข้าร่วมการวิจัย ได้อ่านข้อความ
ข้างต้นและมีความเข้าใจดีทุกประการแล้ว ยินยอมให้ ด.ช./ด.ญ./นาย/นาง/นางสาว
_____ เข้าร่วมการวิจัยด้วยความสมัครใจ จึงได้ลงนามในเอกสารใบยินยอมนี้
ลายมือชื่อผู้แทนโดยชอบธรรม/ผู้ปกครอง_____ วัน-เดือน-ปี_____
              (_____)

APPENDIX C

CASE RECORD FORM

Patient ID: ……………………Number of visit ……………….Date:…………………

PATIENT ASSESSMENT FORM

1. Wrinkle severity rate score (WSRS)

Score	Nasolabial severity	
	Left	Right
1		
2		
3		
4		
5		
Mean		

2. Anatomical position of the Facial Artery in the Nasolabial areas:
   A. Subdermal layer
   B. Subcutaneous layer
   C. Intramuscular layer
   D. Supra-periosteal layer
   E. Absent

3. The depth of the Facial artery nasolabial folds (mm):
   A. Left NLF:……………………..
   B. Right NLF:…………………...

4. The thickness of Nasolabial structures (mm):

Nasolabial fold	Left nasolabial fold	Right nasolabial fold
Skin		
Subcutaneous layer		
Muscle		

5. Filler types (for subjects who have received filler)

Filler types of findings	Left NLF	Right NLF
1. Hyaluronic acid filler (HA)		
2. Polycaprolactone		
3. polymethylmethacrylate		
4. Calcium Hydroxyapatite		
5. Others		

Describe findings:

……………………………………………………………………………………
……………………………………………………………………………………
……………………………………………………………………………………
……………………………………………………………………………………
……………………………………………………………………………………
…………………

DO NOT PUBLISH INFORMATION

RESEARCH PROFILE (CONFIDENTIAL)

ID:………………

General information (only official)

1. Date:
2. Name:
3. Age:……….years
4. Hospital number:
5. Address:…………………………
6. Tel:
7. E-
    mail:………………………………………………………………………………
    …………………………
8. Occupation:

   ☐ Government officer

   ☐ Employer

   ☐ Housewife

   ☐ Student

   ☐ Employee

   ☐ Others (specify)

   …………………………………………………………………………………………
   ……………………………………………………………
9. Underlying diseases

   …………………………………………………………………………………
   …………………………………………………………………………………
   …………………………………………………………………………………
   ……………………………………………….

10. Types of filler injections (for received filler):

☐ CaHa (Calcium Hydroxyapatite)

☐ Hyaluronic acid filler

☐ PMMA

☐ Polycaprolactone

☐ Others

(specify)…………………………………………………………………………

………………………………………

11. Duration of filler injection:

☐ 1 year

☐ 2 years

☐ 3 years

☐ Other

…………………………………………………………………………………

………………………………………………………

12. Any complications:

☐ History of vascular occlusion

☐ Palpable lump/nodule

☐ Erythema

☐ Bruisisng

☐ Ulcer

☐ Other

…………………………………………………………………………………

………………………………………………………

13. History of following treatments before study

☐ Threat lift

☐ Radiofrequency

☐ HIFU Treatment

☐ Fat grafting

☐ Other treatments(specify)

…………………………………………………………………………………

…………………………………………………………….

14. Medical History
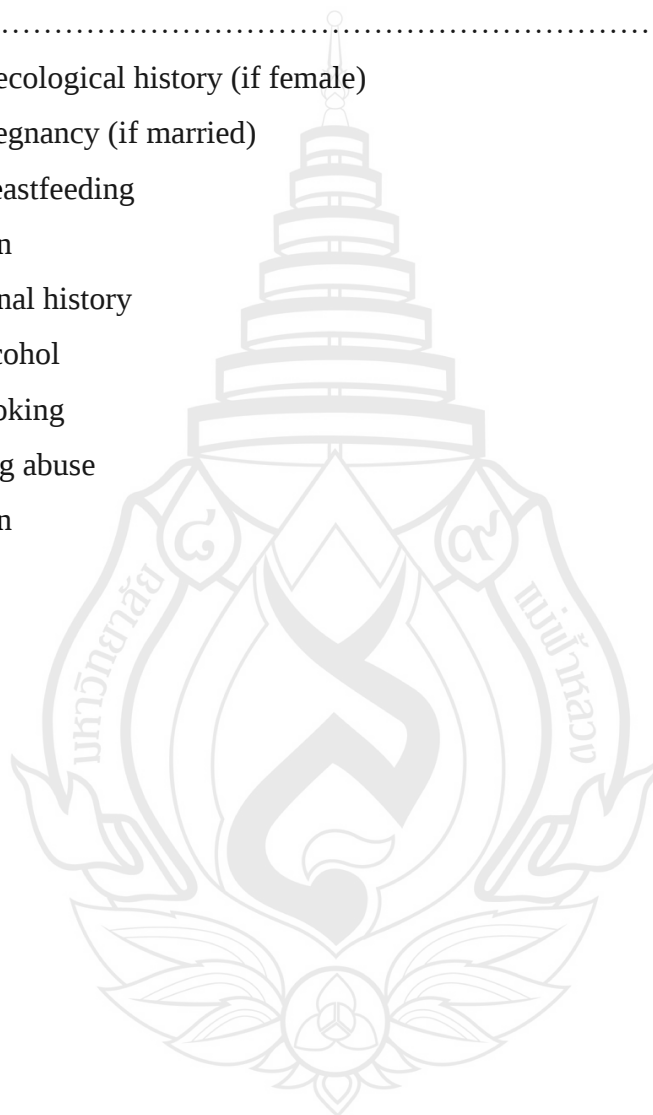
☐ History of malignancy or pre-malignancy

☐ Chemo-radiotherapy

☐ Other (specify)

…………………………………………………………………………………

…………………………………………………………………….

15. Gynaecological history (if female)

☐ Pregnancy (if married)

☐ Breastfeeding

☐ Non

16. Personal history

☐ Alcohol

☐ Smoking

☐ Drug abuse

☐ Non

APPENDIX D

POSTER

APPENDIX E

TABLES

Table E1 Demographic Data

Case No.	age	gender	history of filler	WSRS right	WSRS left
T1	28	F	No	2	2
T2	28	F	No	2	2
T3	28	F	No	2	2
T4	33	F	Yes	3	3
T5	39	F	Yes	3	3
T6	29	F	No	2	2
T7	40	M	No	3	3
T8	25	F	No	1	1
T9	25	F	No	2	2
T10	42	F	Yes	2	2
T11	29	F	No	1	1
T12	36	M	No	2	2
T13	46	F	Yes	5	5
T14	39	F	No	3	3
T15	39	M	No	3	3
T16	35	M	Yes	2	2
T17	34	M	No	3	3
T18	25	F	No	2	2
T19	43	F	Yes	3	3
T20	41	F	No	3	3
T21	42	F	No	4	4
T22	30	F	No	2	2

Table E1 (continued)

Case No.	age	gender	history of filler	WSRS right	WSRS left
T23	28	F	No	3	3
T24	30	F	No	3	3
T25	33	F	No	3	3
T26	41	F	No	3	3
T27	44	M	No	4	4
T28	30	M	Yes	3	3
T29	33	F	Yes	3	3
T30	25	F	No	2	2
T31	39	F	No	3	3
T32	29	F	No	3	3
T33	27	F	No	2	2

Table E2 Soft Tissues 'Thickness in mm Between Filler and No Filler Injection on the Right NLF

Case No.	D1	D2	D3	D4	Filler
Soft tissues' thickness of right nasolabial fold (A; lateral to the nose)					
T1	1.9	3.6	5.3	10.2	No
T2	1.8	3.5	5.5	11.3	No
T3	1	2.2	3.6	8.5	No
T4	1.6	3.7	6.5	13.1	Yes
T5	2.4	4.8	6.9	12.4	Yes
T6	1.9	3.4	5.4	8.2	No
T7	2.6	3.3	6.2	10.9	No
T8	1.9	3.7	5.9	11.6	No
T9	1.5	1.6	3.3	6.3	No
T10	1.5	2	3.7	8.3	Yes
T11	1.9	2.8	4.4	11.2	No

Table E2 (continued)

Case No.	D1	D2	D3	D4	Filler
Soft tissues' thickness of right nasolabial fold (A; lateral to the nose)					
T12	1.5	2	3.7	6.6	No
T13	1.1	2.4	3.6	7.4	Yes
T14	1.9	3.2	5.1	10.2	No
T15	2.2	4	6.1	9.7	No
T16	1.8	2.8	4.5	10.1	Yes
T17	1.9	2.4	4.2	8.4	No
T18	1.7	5.1	7.1	12.9	No
T19	0.9	2.2	3.1	7.1	Yes
T20	2	3.6	5.6	10.9	No
T21	1.6	2.4	4.2	6.5	No
T22	2.6	3.3	6.2	10.9	No
T23	1.8	3.3	5.1	10.8	No
T24	1.9	2.6	4.6	8.9	No
T25	1.8	2.9	5.1	8.9	No
T26	1.9	3	5	11	No
T27	1.4	2.9	4.4	10	No
T28	2	2.9	4.8	12.8	Yes
T29	0.9	3.2	4.1	8.3	Yes
T30	1.2	2.8	4	10.6	No
T31	1.8	2.3	4.6	8.5	No
T32	1.1	2	3.1	7	No
T33	2	3.9	5.5	12	No

Table E3 Soft Tissues 'Thickness Between Filler and No Filler Injection on the Left
NLF

Case No.	D1	D2	D3	D4	Filler
Soft tissues' thickness left nasolabial fold (A; lateral to the nose)					
T1	1.7	2.5	3.9	8.8	No
T2	1.5	2.8	4.3	8.4	No
T3	1.7	2.5	4.3	11.1	No
T4	2.3	3.5	5.8	12.1	Yes
T5	2.5	4	6.5	9.3	Yes
T6	1.8	3.1	4.8	10.4	No
T7	2.3	2.3	4.6	9.9	No
T8	2.4	3.1	5.5	11.7	No
T9	1.5	1.7	3.2	6.8	No
T10	2.1	3.6	5.6	14.7	Yes
T11	1.9	3.6	5.3	14.7	No
T12	1.9	1.9	3.9	8.3	No
T13	1.6	3.1	4.6	11.2	Yes
T14	1.9	3.8	5.6	9.8	No
T15	2	3.3	5.2	10.9	No
T16	2	2.6	4.5	11.3	Yes
T17	1.9	2.4	4.2	8.6	No
T18	1.4	2.4	3.6	13.1	No
T19	1.2	3.7	4.9	12.3	Yes
T20	2.5	4.1	6.7	13.1	No
T21	1.5	2	3.4	8.1	No
T22	2.3	2.3	4.6	9.9	No
T23	1.8	3.3	5	8.9	No
T24	2.3	2.6	5.3	12.6	No
T25	2.2	2.2	4.6	9.7	No
T26	2.1	4.1	6	12.9	No

Table E3 (continued)

Case No.	D1	D2	D3	D4	Filler
Soft tissues' thickness left nasolabial fold (A; lateral to the nose)					
T27	2.2	4.8	6.9	13.1	No
T28	1.6	3.4	4.7	13.5	Yes
T29	1	3.2	4.4	10.6	Yes
T30	1.7	3	4.7	11.3	No
T31	1.9	2.5	4.2	12.1	No
T32	1.8	2.8	4.4	8.1	No
T33	1.6	2.9	4.6	10.9	No

Table E4 Soft Tissue Thickness Between Filer and No Filler in Mm

Case No.	Right D1.mm	Right D2.mm	Right D3.mm	Left D1	Left D2	Left D3	History of filler
Soft tissues' thickness of right and left nasolabial fold (B, mid-point)							
T1	1.8	3.6	5.7	1.1	2.4	3.4	No
T2	2.1	3.5	5.4	2.1	2.7	4.1	No
T3	1.5	3.5	5.4	1.9	3.5	5.8	No
T4	1.6	3.6	5.2	1.9	4	6.4	Yes
T5	2.8	3.9	6.6	2.2	2.7	5.1	Yes
T6	2.3	2.7	4.9	2.1	3.9	6.1	No
T7	2.5	2.5	5	2.5	3.3	5.8	No
T8	1.7	3.3	5	1.7	3.4	5.3	No
T9	2.2	3.8	6.1	1.7	2.7	4.5	No
T10	1.8	3.1	5.1	1.8	3.2	5.1	Yes
T11	2.1	3	5	2.4	2.9	5.6	No
T12	2.1	3.2	5.3	1.9	3.3	5.4	No
T13	1.4	2.7	4.1	1.5	3.2	4.8	Yes
T14	2.3	2.4	4.6	2.1	4.3	6.5	No

Table E4 (continued)

Case No.	Right D1.mm	Right D2.mm	Right D3.mm	Left D1	Left D2	Left D3	History of filler
Soft tissues' thickness of right and left nasolabial fold (B, mid-point)							
T15	2.4	4	6.2	2	4.1	6.2	No
T16	2.4	3.1	5.5	2.8	3.5	6.2	Yes
T17	2.3	3.6	5.8	2.5	3.1	5.6	No
T18	2	3.3	5.2	1.8	4.4	6.8	No
T19	2	3.2	5.1	1.9	5.8	7.3	Yes
T20	1.7	3.1	4.8	2.2	2.9	4.6	No
T21	1.5	2.3	3.9	1.7	5.2	7	No
T22	2.5	2.5	5	2.5	3.3	5	No
T23	2.1	3.1	5.5	2.3	3.6	6.3	No
T24	2	2.1	4.7	2.2	4.6	6.8	No
T25	1.8	4.2	6.2	2.1	3.5	6	No
T26	1.7	3.2	4.6	2.1	3.4	5.4	No
T27	2.3	2.5	4.7	2.1	3.9	6.3	No
T28	1.8	3.9	5.6	2.2	3.3	5.5	Yes
T29	1.4	2.8	4.2	1.7	2.7	4.2	Yes
T30	1.6	3.2	4.9	1.7	3.5	5.5	No
T31	2	2.8	4.8	2	3.1	5.3	No
T32	2	3.8	5.8	2	3.5	5.4	No
T33	2	2.2	4.3	2	3.4	5.1	No

Table E5 Soft Tissues Thickness Between Filler and No Filler in Mm

Case No.	Right D1	Right D2	Right D3	Left D1	Left D2	Left D3	History of filler
Soft tissues' thickness of right and left nasolabial fold							
(C, 1-2cm near corner of mouth)							
T1	1.8	2.6	4	1.9	2.4	4.1	No
T2	1.8	3.5	4.7	1.8	3.5	5.2	No
T3	1.5	2.7	4.2	1.9	3.3	5.4	No
T4	1.8	5	6.8	2.1	5	6.9	Yes
T5	2.1	3.5	5.9	2.3	4.1	6.2	Yes
T6	2.1	3.8	5.8	2	3.2	5	No
T7	2.3	3.5	5.7	2.8	3.9	6.3	No
T8	1.4	3	4.4	1.4	2.8	4	No
T9	1.5	5	6.6	1.4	4	5.6	No
T10	1.4	3.9	5.3	1.4	2.5	3.7	Yes
T11	2.2	2.4	4.7	1.7	2.9	4.6	No
T12	1.4	2.5	4.8	1.5	2.1	3.4	No
T13	1	2.2	3.3	1.6	4.3	5.7	Yes
T14	1.6	2.6	4.3	1.9	2.7	4.6	No
T15	2.1	3.9	5.8	1.6	3.1	4.6	No
T16	2	3.1	5.1	2	2.5	4.4	Yes
T17	2.2	2.2	4.2	2.1	2.5	4.8	No
T18	1.6	2.3	3.6	1.3	4.1	5.3	No
T19	1.4	2.2	3.4	1.5	5.9	6.9	Yes
T20	1.6	2.4	4	1.4	3.7	5.3	No
T21	1.5	1.9	3.5	1.6	4.2	5.7	No
T22	2.3	3.5	5.7	2.8	3.9	6.3	No
T23	2.2	2.6	4.7	1.6	2.9	4.8	No
T24	1.9	3.2	5.5	2.2	4.9	7.1	No
T25	1.9	3.1	5.2	2	3.8	5.8	No

Table E5 (continued)

Case No.	Right D1	Right D2	Right D3	Left D1	Left D2	Left D3	History of filler
			Soft tissues' thickness of right and left nasolabial fold				
			(C, 1-2cm near corner of mouth)				
T26	1.7	3.2	4.6	1.5	4.6	6.3	No
T27	2.4	3.6	6.3	2	2.9	4.7	No
T28	1.9	4.8	6.6	1.9	4.5	6.5	Yes
T29	1.7	2.7	4.4	1.4	3.2	5	Yes
T30	1.2	3.2	4.7	1.2	3.5	4.8	No
T31	1.9	3.1	5	1.8	3.7	5.5	No
T32	1.8	3.2	5.1	1.8	3.4	5.2	No
T33	1.7	2.7	4.6	1.7	4.5	0.65	No

Table E5 Depth of Facial Artery in Filler and No Filler Both Left and Right Side

Case No.	RN1	RN2	RN3	LN1	LN2	LN3	History of filler
T1	7.1	6.1	7.2	4.6	5.7	4.8	No
T2	8.5	5.4	1.5	5.1	4.7	8.7	No
T3	4.8	5.4	5.6	9.5	9	6.3	No
T4	4.7	4.8	7.6	8.5	4.6	9.7	Yes
T5	4.4	0	3.3	4	4.4	9.6	Yes
T6	5.9	5.1	8.5	4.7	5.1	8.3	No
T7	6	6.5	6.9	4.8	4.8	7.4	No
T8	0	0	0	5	4	7.1	No
T9	4.4	3.7	6.2	4	7.8	7.9	No
T10	2.4	0	4.8	0	0	6.2	Yes
T11	5.6	5.2	6.3	3.5	4.9	5.8	No
T12	3.5	3.5	4.3	3.7	0	4.2	No
T13	6.4	8.1	5.3	10.3	7.2	9.1	Yes

Table E5 (continued)

Case No.	RN1	RN2	RN3	LN1	LN2	LN3	History of filler
T14	4.6	4.9	6	6.4	0	6.4	No
T15	6.1	0	9	10.2	0	8.2	No
T16	9.3	3	6.5	8.8	8.1	5.8	Yes
T17	0	0	7.2	2	0	7.3	No
T18	9.6	9.5	11.2	5.3	5.1	5.8	No
T19	4.6	4.7	7	7.9	9.9	8.5	Yes
T20	6.9	4.3	5.1	9.1	3.3	2.2	No
T21	3.1	2.8	5.3	5.9	11.4	3.2	No
T22	3.5	2.8	4.2	8.7	3.7	6.5	No
T23	5.8	0	6.3	7.4	0	6.1	No
T24	5.6	5.8	3.8	8.5	2.8	7.2	No
T25	6.1	5.3	7.5	6.3	4.3	5	No
T26	4.4	0	6.5	3.5	0	9.6	No
T27	0	4	5.7	5.7	3	5.3	No
T28	13.7	0	7.4	5.8	0	7.5	Yes
T29	3.4	4.9	5.3	6.9	2.5	6.8	Yes
T30	7.7	3.2	4.8	4.9	3.5	5.3	No
T31	4.2	8.9	5.4	8.9	8.5	5.8	No
T32	4.2	4.9	5.2	7	0	7.1	No
T33	8.7	3.4	6	8.4	0	6.2	No

Note RN1: Right nasolabial point A, RN2; Right nasolabial point B, RN3: Right nasolabial point C,

LN1: Left nasolabial point A, LN2: left nasolabial point B, LN3 : left nasolabial point C

Table E6 Position of Facial Artery Filler and No Filler on Both Left and Right
Nasolabial Fold

Case No.	RN1	RN2	RN3	LN1	LN2	LN3	History of filler
T1	SP	IM	IM	IM	IM	IM	No
T2	IM	IM	SD	IM	IM	IM	No
T3	SP	IM	IM	IM	IM	IM	No
T4	SC	SC	IM	SP	SC	IM	Yes
T5	SC	.	SC	SC	SC	IM	Yes
T6	SP	IM	IM	IM	IM	IM	No
T7	IM	IM	IM	SC	SC	IM	No
T8	.	.	.	SC	SC	IM	No
T9	IM	SC	IM	IM	IM	IM	No
T10	SD	.	SC	.	.	IM	Yes
T11	IM	IM	IM	SC	SC	IM	No
T12	SC	SC	IM	SC	.	IM	No
T13	IM	IM	IM	SP	IM	IM	Yes
T14	SC	IM	IM	IM	.	IM	No
T15	SP	.	IM	SP	.	IM	No
T16	SP	SC	IM	IM	IM	IM	Yes
T17	.	.	IM	SD	.	IM	No
T18	IM	IM	IM	IM	IM	IM	No
T19	IM	SC	IM	IM	IM	IM	Yes
T20	SP	SC	IM	IM	SC	SD	No
T21	SC	SC	IM	SP	IM	SC	No
T22	SC	SD	SC	IM	SC	IM	No
T23	IM	.	IM	IM	.	IM	No
T24	IM	IM	SC	SP	SD	IM	No
T25	SP	SC	IM	SP	SC	SC	No
T26	SC	.	IM	SC	.	IM	No
T27	.	SC	SC	SP	SD	IM	No

Table E6 (continued)

Case No.	RN1	RN2	RN3	LN1	LN2	LN3	History of filler
T28	SP	.	IM	IM	.	IM	Yes
T29	SC	IM	IM	IM	SD	IM	Yes
T30	SP	SC	IM	IM	SC	IM	No
T31	IM	IM	IM	SP	IM	IM	No
T32	IM	SC	IM	SP	.	IM	No
T33	SP	SC	IM	SP	.	IM	No

Note SP; supra-periosteal layer, IM; Intramuscular layer, SC; subcutaneous layer, SD;

Subdermal layer , ' . 'mean absent artery

APPENDIX F

ULTRASOUND MACHINE

Figure F1 High-frequency Ultrasound Machine (Venue GE Healthcare, US)

CURRICULUM VITAE

CURRICULUM VITAE

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