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PROFILE OF KELOID PATIENTS IN SURGICAL WOUNDS: A STUDY AT DEPARTMENT OF PLASTIC AND RECONSTRUCTIVE SURGERY, DR. SOETOMO GENERAL ACADEMIC HOSPITAL, SURABAYA, INDONESIA (2019-2022)

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ABSTRACT

Introduction: Keloid formation is an abnormal scarring process resulting from disruptions in wound healing. Clinically, keloids extend beyond the original wound margins and progressively enlarge into dense, firm nodules. They can develop following various forms of trauma, including surgical procedures. Several factors contribute to keloid formation in surgical wounds, including age, gender, genetics, skin color, hormones, incision location, wound tension, and delayed healing.

Methods: This retrospective descriptive study analyzes medical records of patients diagnosed with keloids due to surgical wounds at the Department of Plastic and Reconstructive Surgery, Dr. Soetomo General Academic Hospital, Surabaya, between 2019 and 2022.

Results: Among 58 keloid patients, 23 developed keloids following surgery. The most common risk factor was a history of previous keloid surgery. The majority of patients were female, aged 17–25 years, students, and had no family history of keloids. The most frequent keloid location was the chest, with an onset of ≥1 year, a size of <20 cm^2, and associated itching. Surgical excision and combination therapy were the most commonly used treatment approaches.

Conclusion: A history of previous keloid surgery is the primary risk factor for keloid formation in surgical wounds. Surgery and combination therapy remain the most frequently employed treatment strategies.

Highlights:

1. Previous keloid surgery mostly caused keloid recurrence.
2. The most common symptom that accompanies keloids in surgical wounds was itching.
3. Surgery and combination therapy were the most used therapy.

INTRODUCTION

Keloid is a condition characterized with an abnormality in wound healing process. [1] During the wound healing process, myofibroblasts that participate in skin contractions enter the process of apoptosis. Lack of apoptosis in myofibroblasts and excessive accumulation, leads to the occurrence of excessive inflammation and the lifting of scars. [2] Keloids grow over the skin beyond the border of the initial lesion, and become larger over time as dense, supple nodules. Keloid scars may cause psychological and social impacts that can reduce the quality of life. Keloids can be accompanied with symptoms such as pain, itching, and contracture.[3] Study conducted at the Faculty of Medicine, Udayana University, as many as 48% of students with keloids had a mild influence on their quality of life. [4] The most common causes that start wounds in keloid are tattoos, acne, burns, injections, insect bites, piercings, vaccinations, abscesses, and surgical procedures.

The incidence of keloids can be estimated to be around 5-10% in Africa, 0-0.1% in Asia, and <0.1% in other countries.[5] It is evaluated that about 100 million individuals around the world developed scars from surgery or trauma. As many as 15% of these scars are abnormal scars such as keloids.[3] Of the 5,774 patients operated on 33 surgical facilities in Zambia between 1993 and 2008, 514 of them developed into keloids. [6] Keloids accounted for almost 9% of all surgical cases in Zambia in 1993-2008. [7] Research conducted in Nothern India, found 107 cases of keloids, and 17.8% of them appeared due to postoperative wounds. The incidence of keloids in Asia is recorded at 0.1% in Japan and 0.15% in Taiwan.[8] In China, a study conducted in 2018-2021 found that the most common causes of keloids were trauma and surgery with the same number at 24.7%. [9] In Indonesia, retrospective studies reported 93 cases in Manado, 56 cases in Surabaya, and 157 cases in Padang between 2011 and 2018.[8-10] At Dr. Soetomo General Academic Hospital in 2014 until 2017, 17.86% of keloid patients were found to be caused by postoperative wounds.[11]

Although most surgical wounds heal without complications, several factors contribute to keloid formation, including age, gender, genetics, skin color, hormones, incision location, wound tension, and delayed healing.[5] Keloids in surgical wound present a significant challenge in clinical practice due to their high chance of recurrence. In the prevention of postoperative scarring, one of the most critical factors that can be modified is wound tension. This is determined by the choice of incision technique, which is to make an incision by following the relaxed skin tension line. In addition, good postoperative wound care management is important for the first three months to produce optimal wound healing, so that it can heal within the expected period of time without complications such as keloids. [12] Adverse wound healing conditions such as infection, wound depth, delayed wound healing and excessive wound tension, are known to be associated with keloid growth.[6]

Keloids resulting from surgical wounds pose a significant clinical challenge due to their high recurrence rate, treatment difficulties, and associated discomfort. Unlike other types of wounds, surgical incisions are often subject to high tension, which contributes to excessive scar formation. Even with surgical excision, keloids frequently return, often growing larger than before, necessitating additional treatments such as corticosteroid injections, laser therapy, or radiation.

Patients with keloids from surgical wounds commonly experience pain, itching, and contractures, particularly if the keloid forms in areas with high mobility, such as joints. This can lead to functional limitations, making everyday movements uncomfortable or restricted. Additionally, keloids can cause significant cosmetic and psychological distress, impacting the patient's self-esteem and quality of life.

Given the high recurrence risk and difficulty in management, preventing keloid

formation in surgical wounds is crucial. This includes using proper surgical techniques (e.g., incisions along relaxed skin tension lines), postoperative wound care, and adjuvant therapies such as silicone gel sheets or pressure dressings to minimize excessive scar formation.

Based on the background regarding the number of keloid cases that occur due to surgical wounds, their impact on the quality of life of keloid patients, and the need for the most recent data on keloids in Indonesia, this study aims to investigate the characteristics of keloids in surgical wounds in the Department of Reconstructive Plastic Surgery & Aesthetics at Dr. Soetomo General Academic Hospital, Surabaya, Indonesia for the 2019–2022 period. This study provides valuable insights by comparing the characteristics of keloids with previous studies and assessing trends in incidence, risk factors, and treatment outcomes. By expanding on earlier research, this study enhances the understanding of keloid formation in postoperative settings and contributes to improved prevention strategies and more effective management approaches for surgical wound-related keloids.

METHODS

This is a retrospective descriptive study by collecting and processing medical record data of keloid patients due to surgical wounds for the 2019-2022 period. The population used is all keloid patients resulting from surgical wounds at the Outpatient and Inpatient Department of Plastic and Reconstructive Surgery at Dr. Soetomo General Academic Hospital, Surabaya, Indonesia for the period of January 1st, 2019 to December 31st, 2022.

The inclusion criteria for this study are keloid patients resulting from surgical wounds who come and/or are treated at the Outpatient and Inpatient Department of Plastic and Reconstructive Surgery at Dr. Soetomo General Academic Hospital, Surabaya, Indonesia. The exclusion criteria for this study are keloid patients caused by other than surgical wounds. Data obtained from medical records were processed according to the inclusion and exclusion criteria. It was grouped using excel and being analyzed descriptively.

RESULTS

The prevalence of patients who came and/or were treated at Dr. Soetomo General Academic Hospital, Surabaya, Indonesia in 2019-2022 amounted to 2,586,528 patients. Of the 113 patients with abnormal scars, the most cases were keloids, with a total of 58 cases. Followed by hypertrophic scars as many as 51 cases. Additionally, there were 4 cases of combined scar types. The highest number of abnormal scar cases was observed in 2019 (59 cases), while the lowest was in 2021 (15 cases). Over the years, keloids remained the most frequently diagnosed abnormal scar type, with hypertrophic scars following closely behind.

Table 1. Distribution of Abnormal Scar Patients

Abnormal Scars	2019	2020	2021	2022	Total
Keloid	26	15	7	10	58
Hypertrophic Scars	32	7	6	6	51
Combination	1	1	2	0	4
Total	**59**	**23**	**15**	**16**	**113**

Table 2. Distribution of Keloid Causes

Causes	2019	2020	2021	2022	Total
Surgical Wound	8	5	2	8	23
Non-Surgical Wound	18	10	5	2	35
Total	**26**	**15**	**7**	**10**	**58**

Table 2 presents the distribution of keloid cases from 2019 to 2022, totaling 58 cases—23 from surgical wounds and 35 from non-surgical wounds. The highest number of keloid cases due to surgical wounds occurred in 2019 and 2022, with eight cases each, while the lowest was recorded in 2021, with

only two cases. In contrast, keloid cases resulting from non-surgical wounds declined significantly, from 18 cases in 2019 to just two cases in 2022. Overall, keloids caused by non-surgical wounds were more prevalent than those caused by surgical wounds.

Table 3. Distribution of Surgical History

Surgery History	Number of Patients	%
Keloid Excision	12	52.17%
Other Surgery	11	47.83%
Total	**23**	**100%**

Among the 23 patients with keloids due to surgical wounds, 12 (52.17%) had a history of keloid excision, while 11 (47.83%) had a history of other surgeries. This suggests that more than half of the patients had previously undergone keloid excision, highlighting the potential recurrence of keloid formation after surgical removal.

Table 4. Gender Distribution

Gender	Number of Patients	%
Man	10	43.48%
Woman	13	56.52%
Total	**23**	**100%**

Based on Table 4, the distribution of keloid due to surgical wounds was obtained in 10 (43.48%) male patients, and in 13 (56.52%) female patients. This study shows that incidence of keloids due to surgical wounds is dominated by female patients with a ratio of 1.3:1. This finding suggests that women may have a higher predisposition to developing keloids following surgical procedures compared to men.

Table 5. Age Distribution

Age	Number of Patients	%
0-5	1	4.35%
5-11	2	8.70%
12-16	2	8.70%
17-25	7	30.43%
26-35	6	26.09%
36-45	2	8.70%
46-55	1	4.35%
56-65	0	0%
> 65	2	8.70%
Total	**23**	**100%**

The highest incidence of keloids due to surgical wounds was observed in individuals aged 17–25 years, with seven cases (30.43%), followed by those aged 26–35 years, with six cases (26.09%). Meanwhile, no cases of keloids due to surgical wounds were recorded in individuals aged 56–65 years.

Table 6. Occupation Distribution

Occupation	Number of Patients	%
Housewife	1	4.35%
Civil servants	1	4.35%
Student	10	43.48%
Farmers	0	0%
Private Employees	2	8.70%
TNI/Polri	0	0%
Entrepreneur/Self-Employed	1	4.35%
Pensioner	0	0%
Under	2	8.70%
Not working	3	13.04%
Others	3	13.04%
Total	**23**	**100%**

Among the 23 patients with keloids due to surgical wounds, the largest group consisted of students, accounting for 10 cases (43.48%). Meanwhile, private employees (8.70%), unemployed individuals (13.04%), and those in other categories (13.04%) were also represented. No cases were recorded among farmers, military/police personnel, or retirees.

Table 7. Distribution of Family History with Keloid

Family History of Keloid	Number of Patients	%
Yes	1	4.35%
No	3	13.04%
No data	19	82.61%
Total	**23**	**100%**

Of the 23 patients with keloids due to surgical wounds, family history information was not available in the medical records for 19 patients (82.61%). Among the four patients whose family history of keloids was recorded, three (13.04%) had no actual family history of keloids, while one patient (4.35%) had a documented family history of keloids.

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Table 8. Distribution of Keloid Locations

Location	Number of Keloids	%
Face	5	12.20%
Ear	10	24.39%
Neck	0	0%
Shoulder	0	0%
Chest	17	41.46%
Back	0	0%
Stomach	0	0%
Upper extremities	7	17.07%
Lower extremities	2	4.88%
Total	**41**	**100%**

There were eight patients who experienced keloid growth due to more than one surgical wound in the same area of the body and also more than one in a different area of the body. In table 8, there are 41 keloids that grow on several parts of the body. The incidence of keloids due to surgical wounds occurred most in the chest area, which was 17 locations (41.46%), followed by the ear area as many as 10 locations (24.29%). Meanwhile keloids due to surgical wounds was not found in the neck, shoulder, and abdominal area.

Table 9. Distribution of Keloid Durations

Duration	Number of Patients	%
< 1 Year	9	39.13%
≥ 1 Year	14	60.87%
Total	**23**	**100%**

In 60.87% cases of surgical wounds, keloids took more than one year to develop, whereas only 39.13% of cases, with a ratio of 1.56:1, developed keloids in less than one year. This indicates that a significant proportion of keloids appear gradually over time, often taking longer than a year to manifest after the surgical procedure.

Table 10. Distribution of Keloid Sizes

Size	Number of Keloids	%
< 20 cm^2	24	58.54%
≥ 20 cm^2	15	36.59%
No data	2	4.88%
Total	**41**	**100%**

In this study, the area of the keloid was measured based on the length and width of the keloid listed on the medical record. Keloids mostly found with a size <20 cm^2 (58.54%), and keloids with a size ≥ 20 cm^2 as many as 15 keloids (36.59%) with a ratio of 1.6:1.

Table 11. Distribution of Keloid Symptoms

Symptom	Number of Symptoms	%
Pain	12	24.49%
Itch	24	48.98%
Contracture	4	8.16%
No symptoms	9	18.37%
Total	**49**	**100%**

There were some patients who experience more than one symptom. The most common symptom found in patients with keloid due to surgical wounds was itching (48.98%), followed by pain (24.49%). The rarest complaint found in patients with keloids due to surgical wounds was contracture (18.37%).

Table 12. Distribution of Therapy Based on Surgical History

Therapy	History		Total	%
	Keloid Surgery	Others		
Surgery	6	4	10	24.39%
Corticosteroid Injection	5	3	8	19.51%
Combination	10	0	10	24.39%
Laser	3	0	3	7.32%
Silicone	0	1	1	2.44%
No data	1	7	9	21.95%
Total	**26**	**15**	**41**	**100%**

Patients with a history of keloid excision most frequently received combination therapy of surgery and corticosteroid injection, with a total of 10 cases (24.39%). Additionally, other therapies administered in this group included surgery alone in 6 cases (14.63%), corticosteroid injection alone in 5 cases (12.20%), and laser therapy in 3 cases (7.32%). Meanwhile, among patients with a history of other surgical procedures, the most common therapy was surgery, performed in 4 cases (9.76%), followed by corticosteroid injection in 3 cases (7.32%)

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and silicone application in 1 case (2.44%). A total of 9 patients (21.95%) had no recorded therapy data in their medical records (Table 12).

Patients with keloids measuring less than 20 cm^2 most frequently received combination therapy of surgery and corticosteroid injection, with 7 cases, followed by surgery alone and corticosteroid injection alone, each with 5 cases. Meanwhile, for patients with keloids measuring 20 cm^2 or more, the most common therapies were surgery and corticosteroid injection, each given in 3 cases. Laser therapy was also more frequently administered in this group compared to those with smaller keloids (<20 cm^2), with 3 cases.

Overall, combination therapy of surgery and corticosteroid injection, as well as surgery alone, were the two primary treatment choices for keloids, each applied in 10 cases (24.39%). Corticosteroid injection therapy was administered in 8 cases (19.51%), while laser therapy was used in 3 cases (7.32%), and silicone treatment was applied in only 1 case (2.44%).

A total of 9 patients (21.95%) did not have documented therapy data in their medical records. This data suggests that treatment choices may vary depending on keloid size, with a tendency for combination therapy to be more commonly used for small to moderate-sized keloids, while laser therapy was more frequently applied to larger keloids (Table 13).

Patients with itching symptoms were the most frequently treated group, with a total of 24 cases. Among them, the most commonly used therapy was surgery in 7 cases (20.41%), followed by corticosteroid injection in 5 cases (18.37%), a combination of surgery and corticosteroid injection in 3 cases (20.41%), and laser therapy in 3 cases (12.24%).

Among patients experiencing pain (12 cases), the most common therapy was a combination of surgery and corticosteroid injection in 3 cases (20.41%), followed by laser therapy in 3 cases (12.24%) and corticosteroid injection in 2 cases (18.37%). No patients with pain underwent surgery as a standalone treatment.

Table 13. Distribution of Therapy Based on Keloid Sizes

Therapy	Size (cm^2)			Total	%
	<20 cm^2	≥20 cm^2	No size		
Surgery	5	3	2	10	24.39%
Corticosteroid Injection	5	3	0	8	19.51%
Combination	7	3	0	10	24.39%
Laser	0	3	0	3	7.32%
Silicone	1	0	0	1	2.44%
No caption	6	3	0	9	21.95%
Total	**24**	**15**	**2**	**41**	**100%**

Table 14. Distribution of Therapy Based on Keloid Symptoms

Therapy	Symptoms				Total	%
	Pain	Itch	Contracture	No Symptoms		
Surgery	0	7	3	0	10	20.41%
Cortico-steroid Injection	2	5	1	1	9	18.37%
Combi-nation	3	3	0	4	10	20.41%
Laser	3	3	0	0	6	12.24%
Silicone	0	0	0	1	1	2.04%
No data	4	6	0	3	13	26.53%
Total	**12**	**24**	**4**	**9**	**49**	**100%**

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For patients with contracture (4 cases), the primary therapy was surgery in 3 cases (20.41%), while 1 case received corticosteroid injection (18.37%). No patients with contracture underwent combination therapy, laser therapy, or silicone treatment.

Meanwhile, among the 9 patients without keloid symptoms, 4 cases underwent combination therapy (20.41%), 1 case received corticosteroid injection (18.37%), and 1 case underwent silicone therapy (2.04%).

A total of 13 patients (26.53%) had no documented therapy data in medical records, with the highest number found in the group with itching symptoms (6 cases), followed by patients with pain (4 cases) and those without symptoms (3 cases).

DISCUSSION

After conducting a study using the medical record patients in 2019-2022 at the Outpatient and Inpatient Department of Plastic and Reconstructive Surgery at Dr. Soetomo General Academic Hospital, Surabaya, Indonesia, 23 cases of keloids caused by surgical wounds were found out of a total of 58 keloid cases. The highest number of cases was recorded in 2019, with 59 patients, followed by a decline in the subsequent years. This downward trend may be attributed to various factors, such as changes in the number of patients seeking treatment, access to healthcare services, or the impact of the COVID-19 pandemic on hospital visits. Non-surgical wounds were more frequently associated with keloid formation than surgical wounds, which may reflect factors such as trauma, burns, or infections as the primary triggers. Additionally, fluctuations in the number of cases from year to year may be influenced by the incidence rate of injuries, wound management methods, or variations in the number of patients seeking treatment. This number tends to increase compared to the previous research conducted at the Department of Reconstructive Plastic Surgery & Aesthetics of Dr. Soetomo General Academic Hospital, in 2014-2017.[9] Another study in Udayana, found as many as 17 cases of keloids that began with a surgical wound.[4] A retrospective study was applied to 125 keloid patients caused by surgical wounds.[13] This indicates that keloids and hypertrophic scars remain a common clinical issue, requiring attention in terms of prevention, diagnosis, and management.

In this study, 12 out of 23 patients with keloids had a history of keloid removal surgery. This indicates that keloid excision does not always prevent recurrence and may even be a risk factor for the formation of new keloids. This underscores the importance of additional preventive approaches, such as adjuvant therapies (corticosteroids, laser, or radiotherapy) after excision to reduce the risk of recurrence. Furthermore, the occurrence of keloids in patients with a history of other surgeries suggests that individual factors, such as genetic predisposition and wound healing processes, also play a role in keloid formation.

There is a difference between keloid excision by general surgeons and plastic surgeons related to surgical strategies, surgical instruments, and wound closure techniques.[14] The choice of excision in keloids can result in larger lesions and even have a recurrence rate of 45-100%.[3] Meanwhile, in this study, 11 patients with keloid due to other surgical wounds, had undergone Coronary Artery Bypass Grafting (CABG) surgery, syndactyl separation, Open Reduction and Internal Fixation (ORIF), Arterial Septal Defect (ASD) closure, and skin grafting. It is known that the tension of the wound after surgery must be properly fixed to prevent the growth of abnormal scars such as keloids. Patients who undergo surgery on certain parts of the body are recommended to be monitored for keloid growth for three to twelve months. Studies show that the use of silicone gel sheets can prevent the formation of keloids in people who are prone to abnormal scarring.[15] Therefore, it is

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important for healthcare professionals to monitor the healing process of postoperative wounds and take appropriate measures to prevent excessive scarring.

The incidence of keloids due to surgical wounds obtained in this study was 23 cases, predominantly female patients with a ratio of 1.3:1. It is likely to be related to the number of patients who came and/or were treated at Dr. Soetomo General Academic Hospital, Surabaya, in 2019-2022, predominantly being women (53.93%). In addition, research conducted at Dr. M. Djamil Padang Hospital in 2016-2020 showed that the incidence of keloids was more in women.[16] A study which was conducted in hospitals in India for 18 months, also stated that keloid cases tend to be predominant in women with a ratio of 1.74:1.5 Keloids tend to occur more often in women due to physiological conditions in the female body and social factors where women tend to pay more attention to their appearance and check themselves in the hospital. In addition, this study indicates that females have a higher tendency to develop post-surgical keloids compared to males. This difference may be attributed to hormonal factors, genetics, or variations in wound healing responses between genders. Estrogen, for instance, is suspected to play a role in fibrosis and excessive collagen production, which may increase the risk of keloid formation. Keloids in this study were also found in the ear. It is known that ear injuries due to ear piercings are considered more common in women.[17] These findings underscore the importance of a more optimal preventive approach for female patients undergoing surgical procedures, especially those with a history of keloids.

It was found that keloid cases due to surgical wounds most often occurred at the late adolescence (17-25 years old). Meanwhile, the incidence of keloids due to surgical wounds was not found at the age of 56-65 years. Study in Udayana found that most keloid cases occurred at the age of 19-20 years.[4] Another study found that most of the keloid cases occuent in patients age 22-30 years.[18] This is likely related to the more active skin regeneration and collagen production at this age, which can increase the risk of excessive scar formation. In contrast, in older individuals, the risk of keloid formation is lower due to slower wound healing and decreased collagen production. Keloids occur more often at the age of 20-30 years because there is higher stimulation of sexual hormones, while in older persons, sexual hormones tend to decrease.[19] In addition, excessive sebaceous secretion and elastic skin conditions in adolescents make them prone to keloid formation.[20] These findings highlight the importance of more optimal keloid prevention and management strategies for younger individuals undergoing surgical procedures.

In this study, most of the patients were students. Research conducted at Manado Hospital in 2011-2015, found that most keloid patients were students.[21,22] During puberty, the production of sexual hormones, as in students, leads to rapid and extensive collagen turnover that can trigger keloid formation.[23] Additionally, the lifestyle and activities of this group, such as stress levels, diet, and repeated minor trauma exposure, may also contribute to keloid formation can increase the risk of skin trauma or minor injuries, which develop into keloids in susceptible individuals. Therefore, educating young and active individuals on proper wound care is crucial.

After a study was conducted through medical records at the Outpatient and Inpatient Department of Plastic and Reconstructive Surgery, family history of keloids data Therefore, educating young and active individuals on proper wound care is essential.

Among the four patients whose medical records indicated a family history of keloids, subsequent verification revealed that three did not, in fact, have any relatives with a known history of the condition. This discrepancy highlights potential issues in the

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accuracy of patient-reported or recorded familial medical histories. A study conducted at Dr. M. Djamil Central General Hospital, Padang reported that 70.2% of individuals with keloids did not indicate a family history of keloid formation.[16] Similarly, another study observed that the majority of keloid patients lacked familial antecedents of the condition.[22] Despite these findings, several studies suggest that a positive family history is associated with an increased risk of developing keloids. Heritability estimates indicate a rate of 72.41% among first-degree relatives and approximately 17% among second- and third-degree relatives.[11] Individuals with a familial predisposition are not only more likely to develop keloids, but also tend to present with multiple and more severe lesions.

These findings underscore the potential role of genetic factors in keloid pathogenesis, though definitive conclusions remain constrained by data limitations, including inconsistent reporting and a lack of genetic profiling. While heredity appears to contribute significantly, particularly in cases with a strong family history other variables such as wound etiology, anatomical location, and individual healing responses are also critical determinants. Consequently, eliciting a detailed and accurate family history should be an integral component of the preoperative assessment. Patients who report a familial tendency toward keloid formation warrant closer clinical attention and a tailored perioperative management strategy to mitigate the risk of hypertrophic scarring and keloid recurrence.

Certain parts of the body are more susceptible to the occurrence of keloids. The study found that the most common keloid location was the chest (41.46%), followed by the ear (24.39%) and the upper extremities (17.07%). Meanwhile, no keloid cases were found on the neck, shoulders, back, or abdomen.

Increased collagen and a decrease in the number of M1 subtype macrophages are characteristic of skin prone to keloid growth in individuals who have a genetic predisposition.[11] It is found that chest is the common area that developed keloid. It is known that keloids are more common in parts of the body with higher skin tension and are prone to stretching in daily activities, such as the chest. The skin of the chest is extended repetitively by the muscle. This constant repetitive stretching causes the wound to widen and trigger the inflammatory process that may lead development of keloids in the wound.[24] Keloids in the ear are also common. Patients of the female may have predominance sex compared to male patients, becauase ear injuries from procedures like ear piercings are thought to be more common in a woman.[17] Keloids occurring in the ears were mostly found to be caused by surgical removal of previous keloids.

Furthermore, these findings confirm that location influences keloid formation risk, suggesting that prevention and treatment approaches should be tailored to high-risk areas, such as using pressure therapy or optimizing wound care in vulnerable locations.

The duration of growth of keloids is the time from the occurrence of the surgical wound to the appearance of keloids. Keloids can grow as fast as in 1-3 months or take more than 1 year after the occurrence of the injury.[25] The majority of keloids occur three to six months after the onset of the injury.[26] However, in this study, it was found that the mostly duration of growth of keloids due to surgical wounds was more than one year. The study indicates that keloids tend to be chronic and can persist for a long time. Keloids that last more than a year may be more challenging to treat and require a more aggressive therapeutic approach, such as a combination of excision, steroid therapy, laser, or radiotherapy. Research conducted at Djamil Padang Hospital in 2016-2020, shows that mostly keloids did to surgical wound took more than 1 year to develop.[16] Other studies show that the longest duration of growth of keloids is up to two years from the

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occurrence of the injury.[27] Additionally, the fact that nearly 40% of cases develop within less than a year highlights that keloids can appear and progress rapidly, making early detection and prompt intervention crucial in preventing further growth.

Knowing the duration of these keloids can help prevent the growth of keloids in the future for optimal monitoring and treatment of postoperative wounds. These findings also emphasize the need for patient education on proper wound care to reduce the risk of persistent keloid formation.

In this study, the size of keloids due to surgical wounds was mostly small to medium sizes. The size of keloids is catagoriesed as: keloids with a size < 20 cm^2 and keloids with a size of ≥ 20cm^2. This indicates that keloids can develop into significant lesions, especially if not properly managed from the outset. The size category used is based on a specific assessment indicator for keloids, namely the JSW Scar Scale (JSS). This scar assessment indicator has been utilized as a standard for assessment abnormal scars in Japan. This scar scale helps to determine the best treatment options for abnormal scars.[15]

The size factor may also influence treatment choices, as larger keloids are often more challenging to treat and more prone to recurrence after procedures such as excision. Therefore, prevention and treatment approaches should be tailored to keloid size to enhance therapeutic effectiveness and reduce the risk of further growth.

Keloids are mostly accompanied by itching. This study shows that itching is the primary complaint among patients with keloids, likely due to the release of inflammatory mediators such as histamine in the excessive wound healing process. Pain is also relatively common, which can affect patient comfort and quality of life.

Elevated TGF-β and histamine in keloids stimulate dermal fibroblasts to produce periostin which can cause itching.[28] Meanwhile, the least complained of symptom in this study is limited movement space or contracture. Although contracture was found in a small percentage of patients (8.16%), this condition can lead to movement limitations if keloids form in joint areas or other mobile body parts. This is related to the theory that contractures are more common in patients with hypertrophic scars than in keloids patient.[29]

The fact that nearly 1 in 5 patients experienced no symptoms is also noteworthy, as it suggests that not all keloids are symptomatic. However, they can still pose aesthetic and psychosocial concerns. Therefore, keloid management should not only focus on treating symptoms but also consider cosmetic factors and the psychological impact on patients.

These data indicate that patients with a history of keloid excision tend to receive combination therapy of surgery and corticosteroid injection as the primary treatment choice (24.39%). This suggests that this combination therapy may be considered more effective in managing post-excision keloids compared to other methods. Meanwhile, for patients with a history of surgeries other than keloid excision, treatment approaches were more varied, with surgery remaining the primary choice (9.76%), followed by corticosteroid injection (7.32%). This may indicate that keloids that develop after other surgical procedures are managed differently compared to those that have already been excised. Additionally, a significant proportion of patients (21.95%) had no therapy data recorded in their medical records, which may reflect a lack of documentation or the possibility that some patients did not receive further treatment after their previous surgical procedure.

In this study, keloids with a size <20 cm^2 were mostly treated using a combination of keloid excision and Corticosteroid injection. Postoperative patients with keloids who undergo combination excision therapy and Corticosteroid injection show a significantly lower recurrence rate in comparison to other treatments such as Corticosteroid injection alone, which has the highest recurrence rate.[13] Keloids with a size of ≥20 cm^2 have

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similar frequency of surgical therapy, Corticosteroid injection, combination, and laser. This is not in line with the theory which suggest that large keloids require a more aggressive approach, such as surgery taken after by postoperative radiotherapy.[30] In any cases of keloid, deep discussion with patients is very important, especially in large keloid cases because the main goal of keloid therapy is to improve appearance and reduce the risk of recurrence.

This study indicates that the choice of therapy for keloids varies depending on lesion size. Combination therapy of surgery and corticosteroid injection was the most commonly used treatment, particularly for keloids measuring less than 20 cm^2. This may suggest that this combination is considered more effective in managing smaller or moderate-sized keloids.

For larger keloids (≥20 cm^2), treatment options were more diverse, with surgery, corticosteroid injection, and laser therapy each being applied in 3 cases. The more frequent use of laser therapy in this group may indicate that it is preferred for larger keloids, possibly because this approach is considered more suitable for reducing size and inhibiting keloid growth.

Additionally, 9 patients (21.95%) had no recorded therapy data, which may reflect either the absence of further treatment or a lack of documentation in medical records. Overall, this data suggests that keloid size may influence treatment selection, with a preference for combination therapy of surgery and corticosteroid injection for smaller to moderate-sized keloids, while laser therapy is more commonly used for larger keloids.

Keloids accompanied by itching were most often treated with surgery,as many as 7 cases. Surgical therapy is also the most widely used choice for keloids with complaints of limited space of movement, which is 3 cases. Meanwhile, keloids that are not accompanied by symptoms are most often treated with a combination of surgery and corticosteroid injection.

Keloids accompanied by pain are mostly treated using a keloid excision and followed with injection of Corticosteroid. Keloids accompanied by itching are mostly treated with surgery or Corticosteroid injection.[18] The administration of Corticosteroid injection is known to help relieve pain and itching. In addition, keloids accompanied by limitation of movement are mostly treated with surgery to reduce pressure and discomfort. Study shows that surgical excision of keloids is the main treatment in cases of keloids accompanied with contractures.[3]

Moreover, the choice of therapy for keloids varies depending on the symptoms experienced by the patients. Patients with itching symptoms were more likely to undergo surgery than other treatments, whereas those with pain tended to receive combination therapy or laser treatment. This may suggest that patients with pain require a multifactorial approach to relieve symptoms and inhibit keloid growth.

For patients with contracture, surgery was the primary treatment choice, indicating that this therapy is considered more effective in addressing movement limitations caused by keloids.

Patients without keloid symptoms still received treatment, with a combination of surgery and corticosteroid injection being the primary option. This suggests that therapy is not solely based on subjective symptoms but also on other considerations such as keloid size or location.

Additionally, a substantial proportion of patients (26.53%) had no recorded therapy data, which may reflect a lack of medical documentation or patients who did not undergo further treatment after diagnosis. Overall, this data suggests that the selection of keloid therapy is influenced not only by symptoms but also by other factors affecting treatment effectiveness.

A history of failure on previous keloid therapy may affect the rate of recurrence of keloids. In this study, patients who had a history of keloid surgery were mostly

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treated with an excision and followed with injecting Corticosteroid. Surgical excision combined with Corticosteroid injection showed a recurrence rate of 15.4%.[31] Keloids caused by surgeries other than keloid excisions are mostly treated with surgery.

It is known that keloid excision can provide better aesthetic results despite a fairly high recurrence rate. However, to decrease the chance of another keloid formation, the surgeon must ensure a tension free wound closure.[32]

This study has several strengths. It analyzes medical records from 2019 to 2022, covering a substantial number of keloid cases and providing valuable epidemiological insights. The findings highlight that keloid excision alone does not prevent recurrence, emphasizing the need for adjunctive therapies. Additionally, the study identifies trends based on gender, age, and anatomical location, aiding in risk stratification. By evaluating different treatment approaches, including surgery, corticosteroid injections, and laser therapy, it contributes to informed clinical decision-making.

However, this study also has some limitations. As a retrospective study, it is subject to biases such as incomplete documentation and missing patient follow-ups. The analysis includes only 23 cases of keloids resulting from surgical wounds, which may not be fully representative. Although hereditary factors are discussed, no genetic testing was conducted to confirm predisposition. Additionally, the study does not track long-term treatment outcomes, making it difficult to assess recurrence over time. Including a control group without keloid formation would strengthen the study by helping to identify protective factors.

In terms of novelty, the study observes a declining trend in keloid cases, potentially linked to decreased hospital visits during the pandemic. It highlights that the chest is the most common site for keloids and discusses the impact of tension on scar formation. Additionally, it links an increased risk of keloid formation to hormonal activity in adolescents and young adults. The study also provides real-world data showing that combination therapy (excision plus corticosteroid injection) is preferred for smaller keloids, while larger keloids are treated with a more diverse approach, including laser therapy.

This study provides a broad overview of keloid formation in surgical wounds, identifying several risk factors such as age, gender, surgical history, family history, occupation, location, size, and symptoms. It is based on secondary data from medical records, which may result in incomplete or missing information that could affect the overall findings and analysis. The study focuses on keloids arising from surgical wounds, which is crucial for surgical planning and patient management. By examining keloids in surgical wounds, this research offers valuable insights into their prevalence and characteristics, potentially guiding future studies, risk assessment, and management strategies.

CONCLUSION

Based on the results, it can be concluded that keloids due to surgical wounds are most commonly caused by previous keloid surgery. Most keloid patients were female, students, and aged 17–25 years. Keloids were most frequently found on the chest, typically small to medium in size, and often accompanied by itching. This study indicates that keloids are primarily treated with surgery and combination therapy.

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CONFLICT OF INTEREST

The authors pronounced that there is no conflict of interest.

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AUTHOR CONTRIBUTION

Designed this study and outlined the draft: DYN. Collected information and performed background literature review: DYN. Performed analysis of the statistics: DYN. Supervised results and discussion: DYN, IDS and DMI. Performed grammar and writing checks, critical analysis of the data, manuscript revision, and ensured compliance with publication guidelines: AD, SA and MM. All authors reviewed and approved the final form of the manuscript.

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