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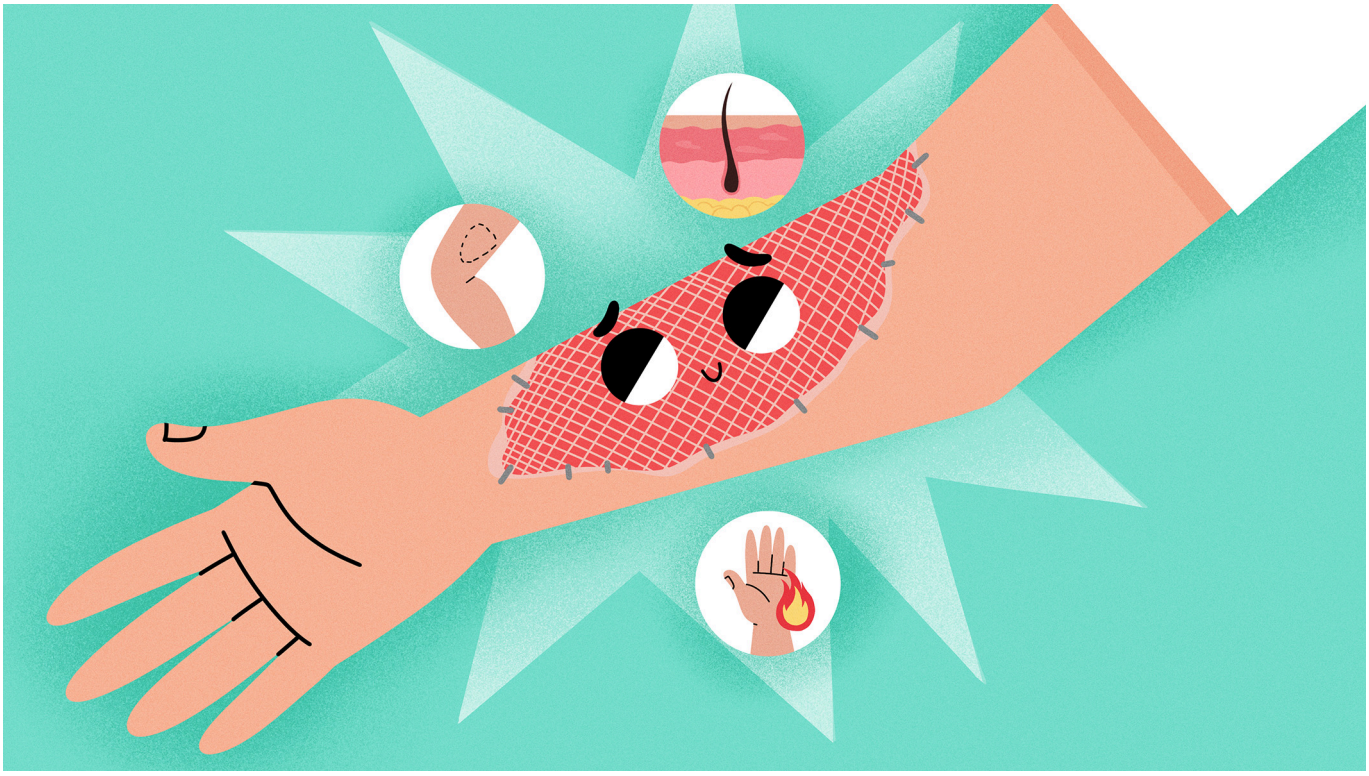
HUMAN HEALTH
Published: 02 October 2025
doi: 10.3389/frym.2025.1513151



HOW SKIN GRAFTS ARE USED TO TREAT BURNS

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YOUNG REVIEWERS:


AADESH
AGE: 14


ALBERT
AGE: 10


ARYAN
AGE: 13


BORAN
AGE: 12


DIYA
AGE: 13


JIAQI
AGE: 12

Burn injuries range from being quite mild, like sunburn, to very severe, like burns from touching fire. Burns cause pain and can result in long-term complications such as scarring or limited function of the affected body part. Burn severity is classified based on how deep the burns are which ultimately affects the recovery process. Skin grafting, which involves replacing burn-damaged skin with healthy skin, can be used to treat severe burns and help them heal. Skin grafts can come from the burn patients themselves for from other people who volunteer to donate some of their skin. This article explores how burns affect the body and describes the science of skin grafts, including how they work and new techniques to improve burn healing, like stem cell therapy.

PRANAV

AGE: 13

RIANA

AGE: 13

SKIN GRAFTING

Putting new skin on an area that has been burnt. It can be the patient's own skin from a different site, donor skin (from someone else), from an animal or from synthetic (manmade) material.

INFLAMMATION

The body's response to an injury, including a burn. It involves redness, heat, pain and loss of function.

COLLAGEN

Protein that makes up tissues in the body.

INTRODUCTION

Every year, millions of people worldwide suffer from burn injuries due to various causes such as fire, hot surfaces, chemicals, and electrical accidents [1]. Burn injuries range from mild (like sunburn) to severe (burns from touching fire). Burns can not only cause significant pain but can lead to long-term problems such as scars and poor function of the burned body part [1]. **Skin grafting** is one treatment that has been used effectively to promote healing and restore skin functions in burn victims [1]. Skin grafts involve transplanting healthy skin to the burn site. This article will discuss burns and how skin grafts can be used to treat them.

WHAT HAPPENS DURING A BURN?

How bad a burn is, also known as its severity, depends on many factors. These include which area(s) of the body was burned, how much of that area was burned, and for how long that area was exposed to the source of the burn [1]. After a burn injury, the body begins to repair the damaged tissue through a process called **inflammation**.

Initially, the burned area shows signs of inflammation, such as redness and swelling, as blood rushes to the burn site carrying white blood cells (WBCs). These WBCs are the "clean up team"; they serve as the front line of defense, fighting any potential bacterial invaders and attempting to stop any infection that could take place. WBCs also release chemicals that help the body fight infection and allow it to heal.

The inflammation phase can also cause pain due to the flow of blood and body chemicals that are trying not only to fight infection, but also to repair the damaged skin. Over approximately three days, the body begins to make **collagen**, an important skin protein that helps to rebuild and strengthen the damaged tissue.

The skin can be divided into three layers (Figure 1). The top layer is the epidermis, then we have the dermis, and under the dermis is the subcutaneous tissue (hypodermis). Burns are classified based on their depth through these layers, with deeper burns being more severe. A summary of burn types and their characteristics is shown in Table 1.

The medical problems that happen following burn injuries can be very severe. The inflammation that occurs after a burn may cause full-body complications, such as low blood pressure and organ damage. The lungs may be injured after inhaling smoke. The kidneys can be injured following inflammation and low blood pressure. Patients are prone to developing infections as well. These complications are usually worse with higher-degree, larger burns [1].

Figure 1

The skin has three main layers: the epidermis, the dermis, and the hypodermis. The severity of burns is determined by how deeply they penetrate through these layers. First degree burns affect only the epidermis. Second degree burns affect the epidermis and dermis. Third degree burns affect all three skin layers and are therefore the most severe.

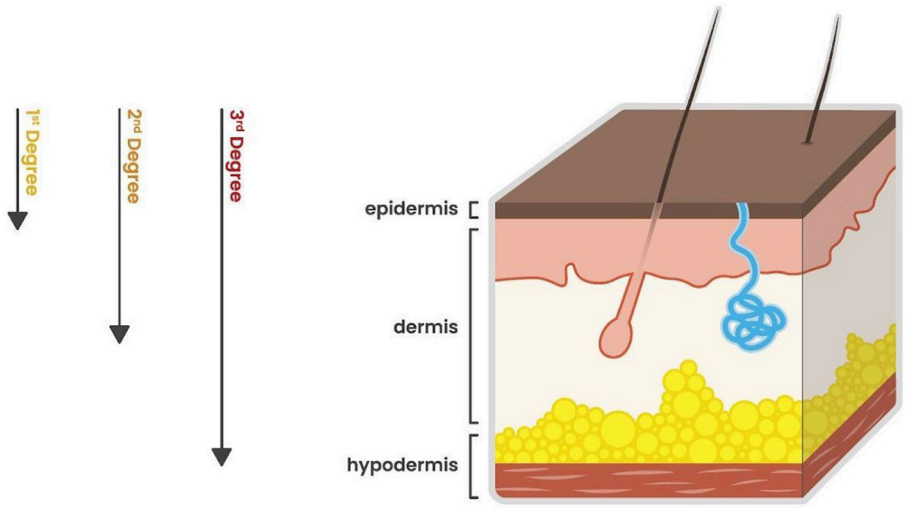

Figure 1

Table 1

Burn classification.

Burn degree	Skin layers affected	Appearance	Healing time
First degree	Epidermis (first/top layer)	Pink and dry	5–10 days (no scarring)
Second degree	Epidermis and surface of dermis (second/middle layer)	Pink or red, blisters (fluid filled pockets)	2–3 weeks (scarring may occur)
Third degree	Epidermis, dermis, hypodermis (third/bottom layer)	Brown or black, leathery and dry	May take months and require surgery to heal

Table 1

THE SCIENCE BEHIND SKIN GRAFTS

Skin grafting is used to treat severe burns. It involves taking healthy skin from a healthy part of the body to treat the damaged area (Figure 2) [2]. Skin grafts vary based on where the skin comes from and what types of burns it can be used for [3]. Autografts come from the patient's own healthy skin in an unburned part of the body. Allografts are taken from another individual of the same species, like from someone who has died. Xenografts are skin taken from animals. For example, pig skin can be used to replace the skin in the burnt area. Allografts and xenografts are temporary solutions until the patient's own skin is healthy enough to be used.

Split-thickness skin grafts (STSGs) are composed of the top layer of the skin (the epidermis and the outer layer of the dermis) and are used for larger wounds. Full-thickness skin grafts (FTSGs) contain all the skin layers and are used for smaller areas. Composite grafts contain skin and other tissue types like cartilage, and they are used if the burn damages the muscles and bones underneath the skin. These grafts also

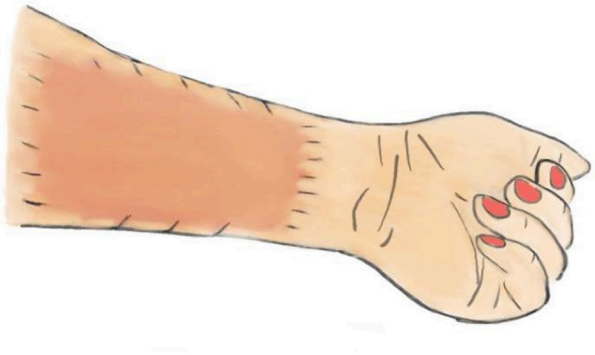

Figure 2

Figure 2

Left arm after a burn and skin graft. There is a rectangular skin graft shown here. The color is slightly different to the patient's arm skin, which can sometimes happen. Sutures (stitches) are seen securing the graft to the patient's arm.

have their own blood supply, so they are ideal for healing wounds with poor blood circulation.

STSGs are the fastest to heal and the least likely to scar because they contain the least amount of skin layers. FTSGs, because they are thicker, take longer to heal but provide more natural-appearing results. Composite grafts also have a long healing time and scar similarly to FTSGs due to their thickness.

PROCESS OF SKIN GRAFTING

The degree of the burn determines the size and thickness of the graft [4]. Most often, skin grafting requires hospitalization to monitor healing and watch for signs of infection [5]. The first step in emergency in-hospital treatment is to give medicines called antibiotics to prevent infection, and pain medication as needed. Then, the burned area is cleaned and damaged tissue is removed. This can be done surgically or non-surgically. Then a burn cream is applied to the wound.

At this stage, the graft can be taken from another body part, which is determined by accessibility, skin color, and wound healing ability. The most common areas are the buttocks, stomach, and thigh. The skin graft is removed using a small razor blade or an electric shaver, and it can then be made into a mesh by using a special machine that puts tiny holes in it. The mesh pattern allows natural inflammatory fluids at the burn site to pass through the holes so they do not lift the graft off the underlying surface as they are produced. After removal, a sponge and dressing are commonly applied to the site where the graft was taken, to decrease blood loss and pain and to speed up skin growth. Sometimes the graft is a slightly different color to the surrounding skin that it is attached to. The way it looks is caused the "cosmetic affect".

The burned area is called the recipient area. The graft can be applied directly onto the recipient area and kept in place by either staples,

SUTURES

Stringlike material used by doctors to sew tissue together; also called stitches.

STERISTRIPS

Thin, tape-like strips of paper that are used to hold tissues together.

PRESSURE DRESSINGS

An external bandage applied to a wound to provide a little pressure to stop fluid from building up inside the wound.

STEM CELLS

Very young cells that have the potential to develop into many different body parts/tissues.

sutures, **steristrips** (paper stitches), or **pressure dressings**. It is kept hydrated with a moisturizing gauze or a covering that protects against air and water exposure. Dressings are usually changed 3 days after the operation and every day thereafter [6].

THE FUTURE OF SKIN GRAFTS AND BURN TREATMENT

Although the overall survival of the skin graft is vital, the appearance of the graft after it heals is equally important. Scars are common after a skin graft procedure and can cause stress, pain, and decreased movement. Additionally, wound healing can take a long time and can lead to changes in skin color.

Many new ideas are being developed for burns treatments and skin grafts [2]. For instance, a potential treatment for scarring is the use of **stem cells**. Stem cells are special cells that can turn into other cell types, making them ideal for wound healing. Another new treatment is the use of silicone, which is commonly used to create a protective layer that acts like a layer of the skin. Silicone has been shown to decrease pain, itchiness, and scar thickness. There has also been an increased use of laser therapy to improve the look of the healed skin after burn injuries. Lasers can help the tissue to repair itself, decrease scar thickness, and improve overall skin function.

Skin tissue engineering is a developing field in which new living tissue can be made to imitate human skin [2]. Much research has focused on producing living tissue that has the appropriate strength and healing abilities. The future of skin tissue engineering looks promising as new advances are being made; however, there is still room for improvement to make sure that engineered skin fits well with the body's own tissue and looks natural.

CONCLUSION

In summary, when the skin suffers a burn injury, the body starts a complicated healing process involving inflammation and tissue repair. The severity of the burn varies from first to third degree, based on depth. Severe burns can lead to complications like infections. Skin grafting is commonly used to treat severe burns and involves transplanting healthy skin to the damaged areas. Various types of skin grafts exist, and each has its own unique healing properties and sources. Despite the success of skin grafting, it often results in scarring and decreased skin elasticity or "stretchiness". Emerging treatments like stem cell therapy, silicone application, and laser therapy aim to improve outcomes. Skin tissue engineering is a new technique that holds promise but requires further development for optimal integration and longevity. Hopefully, continued research into skin

grafting will help people with severe burns to have better function and cosmetic effect.

AI TOOL STATEMENT

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SUBMITTED: 17 October 2024; **ACCEPTED:** 15 September 2025;
PUBLISHED ONLINE: 02 October 2025.

EDITOR: Réka Mizsei, Dana–Farber Cancer Institute, United States

SCIENCE MENTORS: Padhmanand Sudhakar and Bing Yang

CITATION: Sikder O, Mahesh D, Gendy N, Sathyamurthy S, Nia T, Bishay F and Connelly TM (2025) How Skin Grafts are Used to Treat Burns. Front. Young Minds 13:1513151. doi: 10.3389/frym.2025.1513151

CONFLICT OF INTEREST: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

YOUNG REVIEWERS

AADESH, AGE: 14
Hi, I am Aadesh, a student with a passionate outlook toward studies. I enjoy studying science and developing my skills in researching and writing. I am always filled with enthusiasm to share my thoughts and ideas with others and learn from their perspectives. In my free time, I enjoy researching various topics and exploring books on astronomy and physics.

ALBERT, AGE: 10
Hello, everyone! I am a fourth-grade primary school student. I am passionate about natural science. I love sports and street dance, too. Also, I really enjoy exploring the unknown mysteries of the universe. That is me, a curious kid!

ARYAN, AGE: 13
Well to start off, my name is Aryan B, studying in The Camford International School. Outside of school, I have many hobbies, especially DRAWING, solving rubicks cubes, love cooking and I am a foodie. I like learning new things. My entire life changed in the COVID-19 pandemic as I had so much time for myself and found the things I am good in and found the things that I like to do. I am grateful for the opportunity I got in reviewing this manuscript. Thank You.

BORAN, AGE: 12
I am at first grade of junior high school. I like sport, music and drawing pictures. I like reading as well. I love to read books about Harry Potter and Conan.

DIYA, AGE: 13
Hey! I am Diya from Tamil Nadu, India. I currently am in grade 8. I am passionate toward both academics and sports. I am a nature enthusiast and I admire its striking beauty. I also enjoy expressing my thoughts through my drawings. I also find delight in reading.

JIAQI, AGE: 12

I am now in junior high school. I really like drawing pictures. I also like computer science and artificial intelligence.

PRANAV, AGE: 13

My name is Pranav and I am studying in Grade 8. I like Science, especially the astronomy part of it and learning about the things that happen outside Earth in the vast space. My hobby is playing football.

RIANA, AGE: 13

I am Riana,a teenager with several hobbies including painting. I consider myself to be a creative individual. Ever since I can remember my ultimate goal in life has always been to be a doctor , it is a goal firmly rooted in my mind unbreakable by anyone ! I want to be a pediatric endocrinologist ! I want to help young girls like myself who have T1D. I also love to do research on various topics, particularly those that are related to biology.

AUTHORS

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Omaike Sikder is a second year medical student at the University of Limerick. He has a background in Biochemistry and Biomedical Sciences and Nursing from his undergraduate studies at McMaster University. Omaike has worked as a cardiac nurse prior to attending medical school. He has conducted research in stroke, COVID-19, and HIV and has interests in pediatrics and knowledge translation. *omaike.sikder@gmail.com

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Dhaarini has a strong background in the medical sciences with a particular interest in adolescent health. Her previous research focused on cell biology with a particular emphasis on angiogenesis using various biological agents, such as Rat2 fibroblast cells and VEGF. Dhaarini aims to use her ongoing knowledge to bridge the intersection between pediatric health, agency, and scientific understanding. In her free time, Dhaarini likes to read and spend time with her family.

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Natalie Gendy is a second-year medical student at the University of Limerick. She completed her undergraduate studies at Western University, specializing in One Health and Pathology. Natalie is passionate about exploring biomedical sciences through various lenses, including economic, policy, and cultural perspectives, to address issues of inaccessibility and unsustainable healthcare. Her research interests focus on the primary prevention of cardiovascular disease, quality of life indicators in treatment, and pediatric and maternal health. In her free time, she enjoys listening to music and playing Candy Crush.

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Subikshan is a second-year medical student at University of Limerick, where he is pursuing his Bachelors of Medicine, Bachelor of Surgery (BMBS) degree. With a passion for both clinical practice and research, Subikshan is particularly interested in internal medicine and public health. He has actively participated in various student-led health initiatives, focusing on improving public health through engaging and educating individuals on the benefits of physical exercise. Subikshan has been apart of various research projects and has conducted research in areas such as physical health, dementia and neuroplasticity.

TINA NIA

Tina Nia is a second-year medical student at the University of Limerick. She finished her undergraduate degree in Chemical Engineering with a specialization in Materials and Manufacturing at the University of Waterloo. Her research background includes work in repurposing waste from chemical manufacturing plants, highlighting her commitment to sustainable practices. Tina is passionate about combining her expertise in engineering with her medical studies, aiming to explore innovative solutions at the intersection of healthcare and technology. Her long-term interests involve how technology can be used to improve patient care and healthcare systems, driving more efficient and effective medical practices.

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Freddy Bishay is a second-year medical student at the University of Limerick with a background in Psychology, Neuroscience, and Behavior, specializing in Mental Health from McMaster University. He has experience creating detailed medical diagrams and has conducted research in areas such as pain self-efficacy, moral injury, and posttraumatic stress disorder. Freddy has authored various articles and textbook sections and is passionate about combining his interests in mental health, resiliency, and healthcare education.

TARA CONNELLY

Ms Tara Connelly is a Consultant General Surgeon with a specialist interest in Pediatric Surgery in University Hospital Limerick, Ireland. Her adult general surgery special interest is inflammatory bowel disease. She is the first appointed adult consultant surgeon with a special interest in pediatric surgery in Ireland and works closely with Children's Health Ireland, the children's hospitals in Dublin. Her post is designed to keep the elective general surgery of children close to home so many children from counties Clare, Limerick and Tipperary will not have to travel all the way to Dublin for surgery. Ms Connelly graduated with honors from the Royal College of Surgeons in Ireland in 2009. She then received her Masters in surgery from the Royal College of Surgeons in Edinburgh. She completed her PhD on Surgical Genetics and IBD from NUI Galway, with her research performed in Milton S. Hershey Medical Center, Penn State College of Medicine in Pennsylvania, USA. After completing surgical training in Ireland, she completed a colorectal fellowship in Cleveland Clinic in 2022 and pediatric general surgery in King's College Hospital in London in 2023. With over 130 publications including seven book chapters on colorectal surgery, Ms. Connelly's research focuses on surgical genetics, biobanking and inflammatory bowel disease.