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The Advantages and Controversies of Allograft Skin

The skin is one of the most intricate organs of the human body. It not only is one of the largest organs contained in the human body encompassing up to 22 square feet, it contains many sweat glands, blood vessels, and nerve endings. The skin on the palms of the hand and the soles of the feet is the thickest, but in most places of the body it measures about 0.10 inches thick. Human skin performs multiple functions. Not only does it form walls against both internal and external pathogens in the environment, it contains many nerve endings that interpret both heat and cold vibration. Skin regulates heat loss, helps prevent water loss, and aids in the interpretation of mood, physical state, and beauty. The two layers of skin are the epidermis that protects against environmental assaults, and the dermis that allows skin to be elastic, strong and durable. Unlike animals, human skin does not contain an underlying muscle sheath. A massive injury to the skin caused by a chemical spill or fire can be a devastating occurrence, both physically as well as mentally. Injuries to the skin can cause the patient to be exposed to infection, heat loss and even death. After a full-thickness injury the epidermis can regenerate, but the dermis heals by forming granulation tissue, later developing into scar tissue. Scar tissue can lead to disfigurement and can cause the skin to become less elastic. When determining possible skin transplantation in full thickness wounds, autograft skin (skin taken from a patient's own

body) cannot be utilized if a wound covers a large percentage of the body. Allograft skin (collagen in skin harvested from cadavers) offers better success in surgery-, as it is chemically treated to remove allergens, heals faster, and acts like a scaffolding for host skin to attach to and produce new skin.

Chemical burns are often hard to treat. Burns can develop into more pronounced ones because of the agents in the chemicals, and how long they take to react to the skin. Swelling and blisters occur after a major burn when skin loses its elasticity. Skin then tightens and shrinks, and produces scar tissue. Without skin, a human loses their natural covering. Therefore, a burn patient needs antibiotics and bandages to form a temporary covering for the skin. A patient also needs to be kept in an atmosphere that is free from germs. Anyone entering their room needs to wear a gown and mask. In addition, anything touching the patient has to be sterilized to avoid infection. Following a massive burn, dead tissue needs to be removed by a debriding agent such as papain-urea. Debridement is performed in a tank from one to two times a day to provide a smooth surface for skin implants. Cindy Broaddus (a chemical burn survivor) states in her text "A Random Act," Each morning I wake up, get a dose of morphine…head to the tank room for daily, sometimes twice a day, debridement. As you might imagine, there is no gentle way to take skin off. I am one giant blister...rubbing them raw is unbearable" (71). Early removal of dead tissue, followed by grafting is optimal for the patient in terms of less blood loss and a shorter stay in the hospital. However sometimes surgical debridement is a choice preferred by some doctors to remove all dead tissue down to living tissue in one procedure. If burns cover a large percentage of the body, patients can die if thermoregulation to the skin cannot be maintained. The use of allograft skin following surgical debridement is controversial to some in that allograft

skin does not contain blood vessels, or hair follicles. However, the use of allograft skin in full thickness injuries, combined with a host dermis can be permanent composite skin substitute. Allograft skin is available up to 0.020 inches to achieve a thick autograft, without material thickness, and offers less of a rejection rate compared to thicker autografts. A primary goal in the use of biologic skin is to provide the patient with a graft that aids in faster healing, and provides a smoother cosmetic appearance. But the optimal goal is to provide a skin graft that provides a matrix that doesn't degrade to early as to expose new host skin tissue.

Biological grafts are skin that is already made. Grafts in this category are allograft (cadaver skin) and xenograft (porcine derived graft). Skin grafts from deceased donors are harvested most often from the back, abdomen and the legs. The entire surgical procedure takes about two hours. Allograft skin is most often preserved by cryopreservation. Some opponents argue that allograft skin is not as readily available as xenograft skin. However, allograft skin is more pliable, and causes less drainage at the wound site. Both grafts in this category do not contain blood supplies; therefore they need blood vessels to grow into them. Once skin is vascularized, it is incorporated. Incorporation of biological grafts usually takes about two weeks. Allograft skin can be grafted by first rehydrating it in a saline solution. Then the allograft is incorporated to a thinner autograft, or it can be sutured or stapled as you would also do with an autograft. One of the most widely known companies producing both allograft skin and xenograft skin is LifeCell. LifeCell produces Alloderm (cadaver skin) and Strattice (porcine derived skin). While xenograft skin is more abundant, it is more often used in hernia repair due to its rigidity. Alloderm has been used successfully in over one million skin graft and implant procedures, and has saved the lives of many burn victims. Currently 14% of LifeCell's profits have been invested

into research, and to aid in the development of new products. Even though the process to develop new skin products has been slow, the development of new products is expected in the near future. The National Institutes of Health awarded LifeCell $1.1 million dollars for research in 2003.

Mary Shelley surely envisioned the use of cadaver parts for scientific research as early as the 1800's when she wrote her novel "Frankenstein." She quoted, "I had selected his features as beautiful. Great God! His (the demon's) yellow skin scarcely covered the work of muscles and arteries beneath…but these luxuriances only formed a more horrid contrast with his watery eyes, his shrivelled (sic) complexion." (43). Many years later, various cadaveric body parts are harvested to gain huge profits and purchased by the highest bidders. The gift of life (the procurement of body parts needed for life saving procedures) is a multi-million dollar medical industry. Stefan Timmermans states in his text "Postmortem," Mark Katches, William Heisel, and Ronald Campbell (journalists from the Orange County Register) revealed that the profit margin for tissue processing is lucrative…the entire tissue trade has sales of about $500 million per year" (243). An entire cadaver's organs and skin can be worth about $220,000. Cadaver skin is literally sold to the highest bidder. Nonprofit tissue banks make their profits by sending bone and tissue to for-profit banks, which in turn pays processing fees to the nonprofits, then sells products to surgeons, hospitals, and transplant centers. The use of cadaveric skin was originally intended only to be used in an altruistic fashion, just for burn victims. However, allograft skin is now used in different applications. A burn patient may experience a delay in receiving surgery due to the unavailability of allograft skin. Xenograft skin is not always an option for burn because of its rigidity. Patients seeking plastic surgeons do not often wait for their procedures.

The popularity of these procedures can raise the price of obtaining allograft skin. So, the most profitable way for big companies to sell their cadaveric skin products is to sell it to plastic surgeons. Because cadaveric skin is most often sold to plastic surgeons for cosmetic procedures, the price to purchase it is sometimes just too costly for hospitals to purchase. Cadaver skin is most often purchased by two conglomerates, Collagenesis Inc. of Massachusetts, and LifeCell Corporation of New Jersey.

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