



## Pathology & Biology Section – 2008

### G72 A Degloving Experiment to Suggest Postmortem Interval: Give the Anthropologist Some Hands From Freshwater

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Following the presentation, the attendee will know the results of a unique experiment to determine the minimum length of time necessary for a pair of human hands to be degloved after being submerged in freshwater at 21°C.

This presentation will impact the forensic science community by using the degloving of human hands to suggest the postmortem interval.

A unique experiment was performed during spring 2007 in response to an unusual request from a defense attorney. In late March 2007 an attorney inquired if human hands could be “degloved” after being submerged in freshwater for a period of 36 hours at a water temperature of approximately 70°F. Of particular interest was the minimum length of time necessary for human hands to be “degloved” under the specified conditions. “Degloving,” or the removal of the entire epidermal skin surface of human hands has been well documented as resulting from both: (1) some types of accident, and (2) natural phenomena occurring after hands have been submerged for an extended period.

In this particular instance specific aqueous parameters needed to be addressed, such as the type of water (freshwater over that of a marine environment), complete submergence of the hands, and a water temperature of approximately 21°C (70°F). Following a preliminary literature review it was determined that most information on degloving was anecdotal (Aggrawa 2005, Anderson and Hobischak 2004, Boyle, Galloway and Mason 1997, Kovarik, Stewart and Cockerell 2005, Rodriguez, 1997). Therefore, a unique experiment was proposed, and ultimately agreed upon.

Over the next few weeks the University of California Davis Donated Body Program (UCD-DBP) in central California was contacted. Specifically, arrangements were made to acquire two freshly harvested human forearms with the intent of soaking them in freshwater, and to the best degree possible, emulating the conditions of a canal described by the attorney and documented by the relevant county's Water Quality Control Board. It seems the canal, which is used for agricultural irrigation and thus well monitored, passes through a county in which a decedent had previously been recovered. At issue was the postmortem interval and thereby a possible alibi for the attorney's client. Water temperature and speed of water flow for the central California canal were recorded throughout the period relevant to the investigation.

Thus, to determine the length of time necessary for degloving to occur a controlled degloving experiment was initiated. By May 18, 2007 arrangements had been made to pick-up two forearms on that date from the UCD-DBP. A left (UCD-07-048-UL-FL) and a right (UCD-07-048-UL-FR)

forearm was acquired from an 89 year-old female who had died from cardiopulmonary arrest shortly before becoming a part of the experiment. Both forearms had been removed from the decedent during the morning of their acquisition. They had been refrigerated until approximately 1400 hours when they were then transported to the CSU, Chico Human Identification Laboratory for the experiment. By 1800 hours on May 18, both the forearms had been prepared for being submerged in a stainless steel water bath maintained at a near constant water temperature of 21°C (70° F) for the next ten days. Preparation included: initial photographs of both the arms and hands, sealing the disarticulated proximal ends with rubber seals and additionally covered with waxed polyseal, preparing the stainless water bath with a thermometer, and filling the bath with un-chlorinated, room temperature, fresh water. The proximal ends of both arms were sealed to prevent water from entering beneath the skin from the disarticulated ends. Additionally, both arms were submerged to slightly below the seals for the same reason.

The arms were then monitored every six (6) to twelve (12) hours for changes in color, odor, and general appearance, including the degree of skin- slippage. Additionally, the water temperature was carefully monitored on each occasion the forearms and hands were checked. The observational process was maintained throughout the first 42 hours of the experiment, after which the arms and hands were checked only twice a day, in the early morning and early evening (i.e., at 600 and 1800 hrs.).

During the entire experimental period the highest and lowest water bath temperature achieved was 24°C and 18°C, (75.2°F and 64.4°F, respectively) while the average water temperature was 20.5°C (68.9°F). Periodically water was removed from the bath and replaced with fresh, unchlorinated water of an appropriate temperature to more accurately reflect the conditions described by the Water Quality Control Board for the canal's condition. Thus, every day from three to four liters, or approximately three to four quarts, of water were removed and replaced.

Both hands acquired the classic “washer women's appearance” during the first six hours and continued to worsen over the first 36 hour period. By the end of the second day (i.e., 42 to 48 hours) deep wrinkles appeared and very minor skin-slippage began to appear. Photos were taken, and neither hand was capable of being “degloved” at the end of 36 hours, nor at the end of 48 hours. By day four both hands had begun to become discolored (dark pink), as gases and odor became apparent. During the fifth day (96-120 hrs.) marbling of black and blue colors was acquired, odor increased, and marked bloat of gases was found at the proximal ends beneath the rubber seals (i.e., the ends where the disarticulation had occurred). During day six (by 141 hrs.) both hands had become increasingly marbled



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black and blue as skin- slippage also increased. During the seventh day (between 160 and 168 hrs.) an attempt to deglove the right hand failed but resulted in tearing the skin on the dorsal surface. The left hand had developed a large blister at the anterior wrist where putrid fluid had accumulated. Gases continued to be produced at the proximal ends of both arms but to a greater extent on the right than the left. Simply, the skin on the left hand was generally more firmly attached than that of the right. Photos were taken of the tear and the blister as well as the general deteriorating condition of both hands. On day eight (182 to 190 hrs.) the degree of skin-slippage increased on the dorsal and anterior surfaces but the skin of all the fingers remained moderately attached. There was a marked difference between slippage on the right versus the left hand, with the right hand proceeding more rapidly. During day nine (at 204 hrs. into the experiment) the right hand was “degloved,” although the skin of some of the fingers and all the fingernails remained attached. The left hand was still not ready to be “degloved” on day ten. However, at 256 hours into the experiment, or after 10.5 days, the left hand was “degloved,” although once again, the skin of some of the fingers and all the fingernails remained attached.

It was concluded that freshly acquired fleshed human hands submerged in freshwater at a temperature of 20.5°C could be “degloved” after a minimum period of nearly 200 hours. However, additionally, it was concluded that because the skin of the fingers as well as the nails never become completely detach during the experiment (as they had in the questioned case) it would very likely take much longer for such degloving to occur. Since all chemical and decomposition processes are temperature dependant the temperature of the water can be expect to play a critical role in the length of time necessary degloving to occur. Also of note, because the experimental hands were acquired from an 89-year-old decedent (i.e., one much older than the decedent prompting the experiment) a decedent's age or health status needs be considered in affecting the experimental result – the attachment and elasticity of connective tissue between the epidermis and dermas in younger versus older persons could be expected to play a role. If that were the case the length of time for degloving to occur in a young healthy male should be expected well after the 36 hour period in question.

### **Degloving, Postmortem Interval, Freshwater Death**