

# Quality improvement of fingerprints of decayed corpses by local thanatopractical processing (Thanatoprint)

## Steigerung der Qualität von Fingerabdrücken von Fäulnisleichen durch lokale thanatopraktische Behandlung (Thanatoprint)

### Abstract

Thanatopractical processing allows morphological reconstruction of even advanced decayed bodies.

By extracting fluids from the body's tissue antemortem tenses and volume can be restored. If bodies are partly subject to thanatopractical processing in the hand region ("Thanatoprint"), fingerprints of high quality can be gathered even in cases of advanced decay. Without this treatment fingerprinting can be extremely difficult, if not impossible. Thanatopractical processing could be applied successfully in cases of partial to subtotal detachment of the epidermis as well. In an interdisciplinary study 400 fingerprints of bodies in various states of decay were examined after application of Thanatoprint. In 76.75% fingerprints were applicable for data entry into AFIS (Automated Fingerprint Identification System); another 11.00% of the fingerprints could be used for the process of non-elimination. Further advantages of the method are low invasivity while maintaining the integrity of the corpse, less time- and material requirement as well as its long-lasting effect.

**Keywords:** thanatopraxy, dactyloscopy, fingerprints, AFIS, decay, putrefaction, decayed body, drowned body, postmortem interval, fingerprinting

### Zusammenfassung

Thanatopraktische Verfahren ermöglichen eine morphologische Rekonstruktion auch bei hochgradig postmortal veränderten Leichen. Dem Gewebe wird Feuchtigkeit entzogen, seine ursprüngliche Spannung und sein Volumen werden wiederhergestellt. Werden Leichen auf diese Weise partiell im Bereich der Hände behandelt (Thanatoprint-Verfahren), können selbst in Fällen fortgeschrittener Fäulnis gute bis sehr gute Fingerabdrücke gewonnen werden. Ohne diese Behandlung ist die Fingerabdrucknahme oft erheblich erschwert, wenn nicht gar unmöglich. Das Verfahren ließ sich auch bei teilweiser bis subtotaler Ablösung der Oberhaut erfolgreich anwenden. In einer interdisziplinären Studie wurden 400 Fingerabdrücke von Leichen verschiedener Fäulnisstadien nach der Anwendung von Thanatoprint untersucht. In 76,75% waren die Fingerabdrücke für eine AFIS (Automated Fingerprint Identification System)-Recherche geeignet, weitere 11,00% ließen sie sich für ein Nichtausschlussverfahren nutzen. Als Vorteile der Methode zeigten sich ferner die geringe Invasivität mit erhaltener Integrität der Leiche, der geringe Zeit- und Materialaufwand sowie die anhaltende Wirkung.

**Schlüsselwörter:** Thanatopraxie, Daktyloskopie, Fingerabdrücke, AFIS, Fäulnis, Fäulnisveränderung, Fäulnisleiche, Wasserleiche, Leichenliegezeit, Fingerabdrucknahme

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## Introduction

Thanatopraxy (Greek: Θάνατος, “death”, or Thánatos, God of Death in Greek mythology and πράττειν, “to act”) provides aesthetically and hygienically faultless exposition and transport of the deceased by various methods and procedures. Whereas public exposition and modern embalming techniques are widely used in the United States, UK and France, thanatopraxy is a rather young and still little known discipline in Germany. Yet it is far more than mere hygienic basic care and body cosmetics in a funeral home. The most relevant task of thanatopraxy from the criminological and forensic point of view is the reconstruction of the original appearance of the deceased even in case of advanced decay, long-term disposition of the body in water and in case of considerable violence.

During thanatopractical treatment a special injection technique (tissue reducing procedure) is adopted, mainly via cervical or femoral arteries [8]. An agent dissolution (formaldehyde, methanol, sodium hydroxide, colorants, perfume, buffer solution, blood-clot dissolving and distribution stimulating agents) as blood replacement slows down decay. It takes approx. 12 hours after injection, until fixation and tissue reduction is terminated. In the next step, any possible skin lesions at the surface are closed with wax or similar tools, continued by a concluding cosmetic reconstruction.

Thanatopractical services are generally provided by undertakers with the additional qualification “Certified Funeral Service Practitioner” (embalmer).

In the context of identification of corpses of unknown origin, traditionally, i.e. holistically applied thanatopraxy can be valuable in supporting police work [8]. Aware of the effectiveness of various thanatopraxy substances used in whole body application, the question arose, whether this effect could also be achieved in a defined region of the body, namely in the hand region, which is of relevance for the identification of unknown corpses by fingerprinting.

Even in times of continuing new refinements of molecular genetic examinations identification of persons with the aid of dactyloscopy is indispensable, in particular with regard to deceased persons [1], [5], [11], [13] because of the uniqueness of fingerprints [15] as well as the relative simple and fast applicability.

In case of advanced decay fingerprinting is considerably difficult, if not impossible [4] because of the softness of the finger pads due to putrefaction [7], [9], [12], [14]. Given these recurring difficulties in dactyloscopy of bodies with a long post-mortem interval in a dry or moist environment, finger pads and palms were chosen as target for our current study.

The aim was to reconstruct volume and tenseness of finger pads and to extract fluids from the tissues (particularly in case of long postmortem interval in a moist environment) in order to create a dry skin surface for fingerprinting.

In traditional bodydactyloscopic practice the volume of the finger pads can be improved in different ways [2], [6],

[10], but none of these procedures ensures a sufficiently extensive drying of the tissue in order to make a reliable high quality fingerprinting (by means of powder, magnetic chippings or colour in situ) possible [4], [7].

In collaboration of the University Hospital of Düsseldorf (Institute of Legal Medicine) and the Criminal Investigation Department North Rhine-Westphalia (SG 31.5 – Operational Case Analysis) thanatopraxy was examined in order to determine, to what extent local thanatopractical tissue reduction technique (“Thanatoprint”) [3] can replace the previously existing procedures for fingerprinting bodies with long post-mortem intervals in dry or moist environment, as these techniques destroy the integrity of the body [2], [6], [10] (amputation of fingers, dissection of the epidermis, which is then used as a finger stall by the examiner).

## Method

Included in the study were bodies with advanced decay on the day of admission [3]. Initial post-mortem examination was carried out with detailed documentation of the findings with special attention to signs due to long post-mortem interval in dry or moist environment.

The radial artery was then dissected with maximal protection of the surrounding tissue and minimal epidermal incision. A venous catheter was then inserted towards the hand as close as possible to the Retinaculum flexorum. The size of the catheter varied according to the diameter of the exposed vessel between 20G x 1¼” (1.1 x 33 mm) und 16G x 2” (1.7 x 50 mm). After preparation of the pre-injection, consisting of 10% Metaflow®, 10% Rectifiant® and 80% lukewarm tap water, 120 ml of this solution were injected into the radial artery. The purpose of this pre-injection was to flush the blood vessels of the hand, restore their flexibility and facilitate the distribution of the reagents of the following main injection into the soft tissue. Only after an exposure time of 15 minutes the pre-injection unfolded its full potential. The reagents of the main injection and their mixing ratio have been designed to facilitate a fast volume increase of the finger pads and a sufficiently dry surface to allow a good adhesion of the colour for the following fingerprinting process at the same time.

A permanent tissue fixation was not intended. The mixture, consisting of 15% Metaflow®, 15% Rectifiant®, 15% Metasyn® and 55% lukewarm tap water, was then injected (Figure 1) until the finger pads felt firm, but not hard. After an exposure time of 30 minutes the first fingerprints were taken, 180 minutes after main injection the second fingerprinting took place.

**Table 1: Stages of decay**

Stage 1	Decay of epidermis			
Stage 2	Decay of epidermis	Glove forming or maggot infestation		
Stage 3	Decay of epidermis	Glove forming	maggot infestation or rupture of epidermis	
Stage 4	Decay of epidermis	Glove forming	maggot infestation	rupture of epidermis



**Figure 1: Position of the catheter during main injection**

Before taking the fingerprints the finger pads were treated with soot powder respectively magnetic powder (Magna Brush) in order to be able to take prints on fingerprint-lifting foil (Spurfix). Date and time of fingerprinting as well as the identification number of the body were marked on the foils. It was also easily possible to use paper and colour at this stage. By this technique a total of 400 fingerprints could be included into the evaluation. Subsequently the quality of fingerprints was surveyed and valuated semiquantitively by experts in dactyloscopy from the Criminal Investigation Department North Rhine-Westphalia (LKA NRW/SG 56.1). Mummification of finger pads was treated as exclusion criterion.

A classification of hands respectively fingers in four different stages of decay was made in order to investigate the effect of the stage of decay on the fingerprint quality (Table 1).

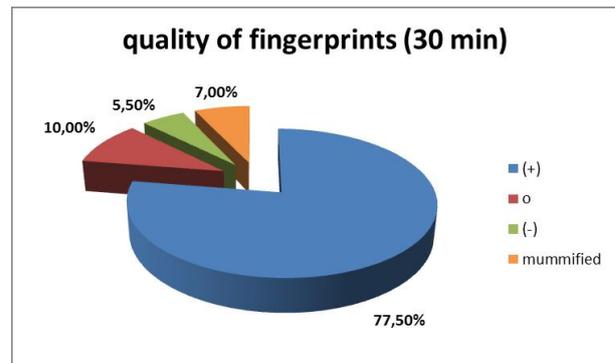
The study was carried out with the consent of the ethics committee of the Medical Faculty of the Heinrich-Heine-University as well as the Departments of Public Prosecution Düsseldorf, Köln and Mönchengladbach. Cooperation existed with Police Departments Düsseldorf, Köln, Mettmann, Mönchengladbach und Neuss.

## Results

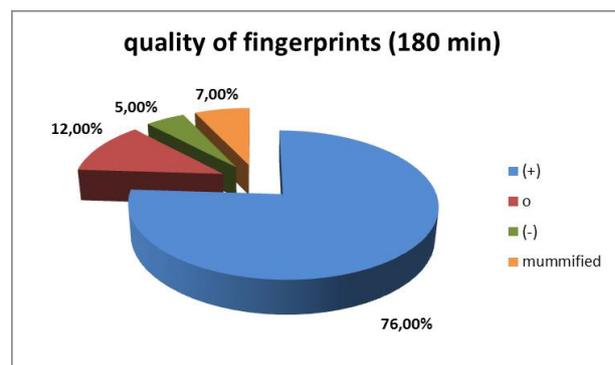
### Time interval post injectionem

77.50% of all fingerprints achieved AFIS-applicable quality after 30 minutes. Another 10.00% were qualified for direct comparison in terms of non-exclusion. 5.50%

of all fingerprints could not be improved in quality so that they could not be used for identification (Figure 2). (As mentioned above, 7.00% fingerprints had to be excluded from evaluation due to mummification of the relevant fingers. Therefore percentage adds up to 93.00% instead of 100%.) 180 minutes post injectionem 76.00% fingerprints were suitable for data entry into AFIS, 12.00% could be used for non-exclusion. 5% fingerprints could not be made useable for identification by Thanatoprint processing (Figure 3). Consequently no significant differences could be seen in reference to the length of time interval between application of Thanatoprint processing and fingerprinting. Fingerprint quality remained on a consistent high level between 30 and 180 minutes post injectionem.



**Figure 2: Quality of fingerprints after 30 minutes** ((+) = AFIS-applicable, (o) = non-exclusion, (-) not usable for identification)



**Figure 3: Quality of fingerprints after 180 minutes** ((+) = AFIS-applicable, (o) = non-exclusion, (-) not usable for identification)

### Stages of decay

140 fingerprints of decay stage 1 (for decay stages see Table 1), 90 fingerprints of stages 2 and 3 each as well as 80 fingerprints of stage 4 were examined. (Due to mummification of the relevant fingers 6.85% fingerprints

were excluded from evaluation in stage 1, 4.45% in stage 2, 6.67% in stage 3 and 17.50% in stage 4. Therefore percentage does not add up to 100%, the values are reduced according to the mentioned percentage numbers.) The percentage of AFIS-applicable fingerprints was highest in stage 1 (82.86%).

The percentage of fingerprints, which were suitable for AFIS search, decreased in higher stages: in stage 2 80.00%, in stage 3 still 75.56% (Figure 4 and Figure 5) and in stage 4 only 63.75% could be used. The percentage of prints, which were only partly AFIS-applicable, but still suitable for non-exclusion, was smallest in stage 1 (6.43%), approximately the same in stages 2 and 3 (13.33% each) and 13.75% in stage 4. The highest percentage of fingerprints, which were not useable for identification, was found in stage 1 (7.86%), followed by 5.00% in stage 4 (4.44% in stage 3 and only 2.22% in stage 2).



Figure 4: Stage of decay 3, before thanatopractical processing



Figure 5: Stage of decay 3, after thanatopractical processing

## Other influencing factors

There were no significant differences with regard to gender or age of the bodies. Cause of death had no effect on either fingerprint quality or applicability of Thanatoprint processing.

## Overall results

In the synopsis of all results (Figure 6) 76.75% of the obtained fingerprints showed AFIS-applicable quality, further 11.00% were suitable for non-exclusion procedure. 5.25% of all fingerprints could not be improved sufficiently by thanatopractical processing to be useable for identification.

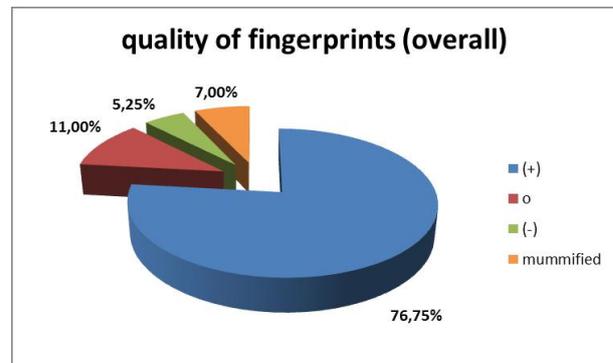


Figure 6: Quality of fingerprints, overall results ((+) = AFIS-applicable, (o) = non-exclusion, (-) not usable for identification)

## Discussion

The traditionally recommended procedure [2] is based on finger amputation, pre-treatment of the amputated fingers (immersing in potassium hydroxide for several hours, at least for half a day, or polyzyme solution with additional warming up to approx. 20 hours), dissection of the epidermis, putting on this skin layer as a finger stall over the gloved finger of the examiner and the taking of fingerprints by rolling the finger stall. This work-intensive and time-consuming procedure does not only destroy the integrity of the body, but often creates psychological stress for the examining person. An alternative procedure is dipping of the hands in hot, but no longer boiling water for a few seconds (cold-/heat-method or "boiling procedure"). Fingerprinting is then carried out immediately to make use of the volume increase due to the heating. The "cooking procedure" can only be used in case of completely intact dermis and offers no fallback solution. Beside the above mentioned procedures direct injection of diverse substances into the finger pads is used to increase the local volume before taking the fingerprints. This may lead to a short term volume increase of single fingers to a varying extent. An additional tissue drying is also needed, because currently injected substances can only increase the volume of the finger pads, but they cannot achieve a dry tissue surface as can be seen in Thanatoprint processing.

In comparison to traditional procedures [2], [6], [10] Thanatoprint also offers several further advantages [3]: The procedure provides high quality fingerprints (76.75% AFIS-applicable, further 11.00% directly usable for non-exclusion procedure). It allows a considerably short wait-

ing period (30 to 40 minutes after starting the treatment until fingerprinting) even in high-grade decayed hands. An almost consistent fixation and volume increase of the finger pads can be expected for a period of at least three hours after treatment. During this period all fingers show a comparable volume and a distinct drying of the epidermis. Because of the access at wrist level palm prints are also feasible for specific issues, if the local epidermis is intact. Thereby Thanatoprint is noticeable less labour-intensive and highly cost-effective due to low costs for raw materials and supplies (as per initial estimate approx. 5 € per application). Using the described technique neither time-consuming epidermis treatment nor repeated intermediate checking for several hours is required. The technique can be carried out by any trained forensic physician or preparator.

The eschewal of finger respectively hand amputations not only ensures the burial of an intact body, which is always to advocate in regard to ethical aspects, but also prevents otherwise arising problems with storage and disposal of the amputated limbs.

Hands with mummified or missing finger pad epidermis are not suitable for Thanatoprint application.

Our results demonstrate that Thanatoprint processing is an effective and efficient alternative procedure to traditional dactyloscopy of decayed bodies. Above all the excellent fingerprint quality, also the preservation of body integrity, easy and fast applicability as well as low effort in costs and personnel are convincing when compared to conventional methods.

## Notes

### Competing interests

The above mentioned reagents, containing formaldehyde, methanol and sodium hydroxide as main agents alongside colorants, perfume, buffer solution, blood-clot dissolving and distribution stimulating agents, are products of Dodge Company.

There is no conflict of interest, the authors do not obtain financial or other benefits from Dodge Company.

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