

# Notes on the techniques of body restoration after autopsy and the possibility of embalming

Jan Frišhons<sup>1</sup> , Maksim A. Kislov<sup>2</sup> , Marcela Bezdickova<sup>3</sup> , Veronika Dzetkucicová<sup>1</sup> 

<sup>1</sup>Department of Anatomy, Faculty of Medicine, Masaryk University, Brno, Czech Republic

<sup>2</sup>Department of Forensic Medicine, Sechenov Moscow State Medical University, Moscow, Russia

<sup>3</sup>Department of Anatomy, Swansea University Medical School, Swansea, United Kingdom

## Abstract

Knowledge of the technique of body restoration, recovery and embalming of corpses is important both from an ethical point of view and from an identification point of view. Conventional autopsy remains one of the main methods of forensic medicine. Different techniques are described within the article starting with basic restoration techniques and describing more advanced and difficult procedures in body reconstructions. Many European and other countries have the necessity of body modification imposed in recommendations or legislation. There are many tried and tested dissection techniques of different body parts that guarantee maximum yield of findings and at the same time an excellent level of reconstruction of the body back to its original state. With high-quality embalming procedures and with the accurate solution choice, only small changes show up as very slow mild dehydration over many months.

**Keywords:** autopsy; body restoration; embalming; preservation; reconstruction

Anatomy 2022;16(2):108–113 ©2022 Turkish Society of Anatomy and Clinical Anatomy (TSACA)

## Introduction

Knowledge of the technique of body restoration, recovery and embalming of corpses is important both from an ethical point of view and from an identification point of view. Despite the development of virtual approaches, conventional autopsy remains one of the main methods of forensic medicine. Knowing appropriate body restoration procedures is essential to treat the body in a dignified and ethical manner. Ideal treatment depends on accurate skin incisions. National laws of each country regulate the body handling after the death. In Europe e.g., Recommendation no. R (99) 3 of Cabinet Ministers' Committee on the coordination of medical-legal autopsy rules; Council of Europe from 2000 and European rule of funeral services EN 15017:2005. Another example, in the Russian Federation, this matter is regulated by the Federal law from 1996 N 8-FZ "Burial and funeral services" and regional laws, e.g., the Law of the City of Moscow from 1997 no. N 11 and Federal Law of 2011 N 323-FZ "Basis on protecting the health of citizens in the Russian Federation".

By volume and purpose, the methods of handling corpses can be divided into several groups. The aim of

this review is to suggest the techniques of body restoration after autopsy and the possibility of embalming documenting the experience of our Institutions.

## Basic Body Restoration After Autopsy

It is performed after each autopsy. The fluids are removed from the open cavities by inserting absorbent material into the cranial cavity, neck and pelvis. Dissected organs are inserted back into the open chest and abdominal cavity. Cavities are covered with absorbent material, sternum placed in a position and the skin is sewed up using the main autopsy suture (**Figure 1**) with a needle puncture at a distance of 0.5–1 cm from the skin incision is sewed up and the body is washed. The stomata and additional openings are closed with a tobacco or Z-shaped stitch (**Figures 2 and 3**).

## Body Restoration After Special Autopsy Techniques

An enucleated eyeball replacement can be shaped from a self-hardening mixture (selfpolymerizing resins, modeling materials, etc.) of an appropriate shape and size and

fixed in a suitable position. Finally, an artificial eye cap is placed under the eyelids. In organs where enucleation is carried out in short postmortem intervals, “hematoma” and edema of the paraplasmic tissues are possible. This artefact can be repaired by dehydration with concentrated ethanol followed by cosmetic adjustment. It is possible to replenish the volume of the destroyed eyeball by injecting a fixation fluid. Reconstruction of the damaged part of the orbit with the eyeball consists of replacing the removed part of the bone with a suitable material and treatment of soft tissues.<sup>[1]</sup> Modification after skull base block removal is possible using a carotid siphon for fixation of the lower jaw and repair of soft tissues with a suitable epoxy adhesive.<sup>[2]</sup> Adjustment after opening the mouth; the removed bone is replaced with a 3D print or with a suitable casting from a different material such as wood.<sup>[3]</sup>

**Reconstruction after block evisceration of the spinal cord by dorsal approach:** the spinal canal is filled with an absorbent material with a retainer, or when fixing the cervical segment of the spine, e.g., with a wire strip wrapped around by a dressing. Removing spinous processes, drilling opposite holes in the occipital bone both at the distal part and at the base and wiring them provide support. Next step is sealing the base with absorbent material, and also the subcutaneous tissue of the back and neck. If the part of the skull’s base is removed, a suitably sized prosthesis is inserted and secured with screws and tiles.

**Reconstruction after dissection of the subcutaneous tissue, vessels, etc.:** The soft subcutaneous tissue is treated with a denaturing agent, a fixative and introduced by an absorbent material. The application of a glove or intradermal suture depends on the location; it is also possible to use cyanoacrylate or tissue adhesive subcutaneously.<sup>[4]</sup> In Russian Federation, the removed part of the skull is usually replaced with a casting from Polyvik polymer (Russian Federation Company) which hardens in 10–15 minutes.

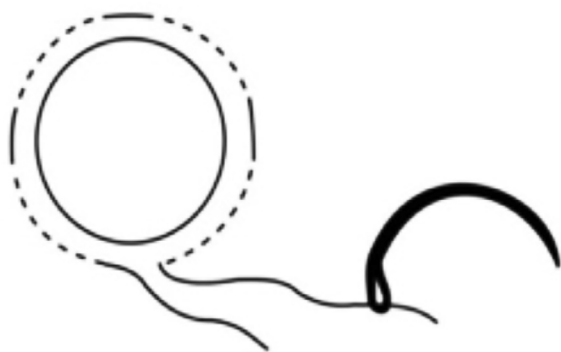


Figure 2. Tobacco stitch. Graphics by Jiri Tauš.

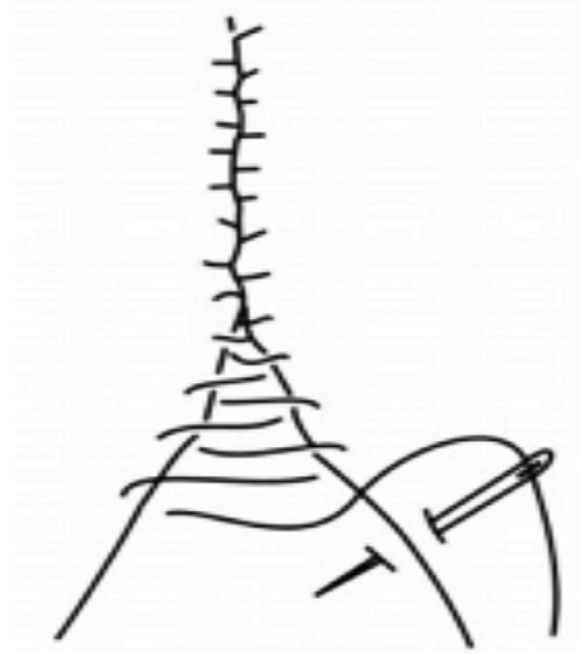


Figure 1. Basic autopsy suture. Graphics by Jiri Tauš.

The base of the skull is covered with long strips of rag soaked in a creamy gypsum mixture. Two strips 50 cm long are casted into the casting for subsequent fixation of the position in the temporoparietal and occipital regions and fixed on the skull and spine. The fixation of the occipital region to the spine is performed in the cervical spine or to the clavicle and from the temporoparietal regions towards the mandibular rami. Subsequently, soft tissue correction is performed.<sup>[5]</sup> Reconstruction after opening the face consists of replacing the removed part of the bones with a suitable material, for example, a 3D print.<sup>[6]</sup> Lobes of soft tissue are fixed with epoxy resin or internal sutures through small holes drilled into the bone. Processing of soft tissues

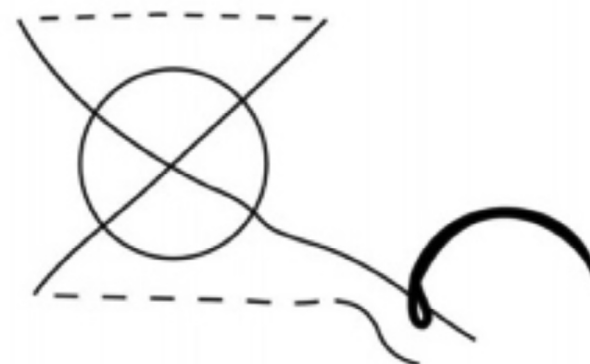


Figure 3. Z suture. Graphics by Jiri Tauš.

is difficult at the root of the nose, zygomatic arches and inner corners of the eyes.<sup>[7]</sup> A piece of cotton wool soaked in 10% formalin is introduced into the external auditory canal. The removed bones are replaced with a 3D print or wooden prosthesis, and their position is fixed with a cable tie or wire. The volume of soft tissues is regulated, for example, with a cloth. Finally, the soft tissues are processed as described above.

### Extended Body Restoration (Health and Safety Protocol)

It consists of adjusting the eyelids, closing the mouth, adjusting the hair, and closing the openings/holes in the body. These adjustments are made at the request of the relatives or according to the requirements. The cranial cavity is filled with absorbent material. The base and vault of the skull are limited from movement by holes in the temporal and occipital regions through which the wires pass, then the absorbent material is inserted under the soft integument of the skull and sutured. The eyelids are closed in a 2:3 ratio of the lower and upper eyelids with a plastic eyelid. An absorbent material is injected into the oral cavity and nasal cavity. The mouth is closed with an internal suture running from the base of the mandible through the vestibule of the mouth through the nasal septum back into the oral cavity where the knot is tied (Figure 4). Hairs are washed dry or damp. After dissection, the clavicles can be brought together using a cable tie through the drilled holes. The skin of the skin incision in the thoracic and abdominal cavities can be perforated before suturing, for example, with a Malco HP18 sheet metal punch.<sup>[8]</sup> The sharp edges of the ribs

are covered with a suitable material. The penis is closed by a ligament in a condom. An absorbent material soaked in a preservative solution is inserted into the rectum and vagina. The whole body is washed with aromatic disinfectant soap. Nail care products and cosmetics can be applied with makeup brush or with an airbrush.

**Reconstruction of body parts** damaged mechanically or otherwise is performed to reduce the psychological trauma of person providing identification. When carrying out reconstruction it is important to observe the anatomical structures using correct proportions. Part of the destroyed skeleton is replaced, for example, with a 3D print, a polyurethane prosthetics,<sup>[9]</sup> plasticine blocks<sup>[10]</sup> and other materials. Lobes of soft tissues are collected by stitching them with intradermal (Figure 5) and other sutures or cyanoacrylate glue and attached to the substrate, e.g., using epoxy resin. The missing parts of soft tissues can be replaced with an autocutaneous graft or reconstructive wax, followed by surface cosmetic adjustments. The restoration can be made from pulp, plaster, bone paste, cotton, paraffin-impregnated cellulose, wool and other materials. When the frame is complete or there are most of the fragments of the frame, they are cleaned, drilled, and wired or connected with small plates. After assembly, the skeleton of the skull is wrapped with foil and a light plaster of paris is poured through a small hole in the temporal bone to strengthen it.<sup>[11-15]</sup> In some cases, it is possible to perform computed tomography of the damaged head with a virtual reconstruction of the skull for subsequent printing missing elements using a 3D printer. If most of the frame is missing, it is necessary to replace this part, for example, with a modified 3D casting. If it is

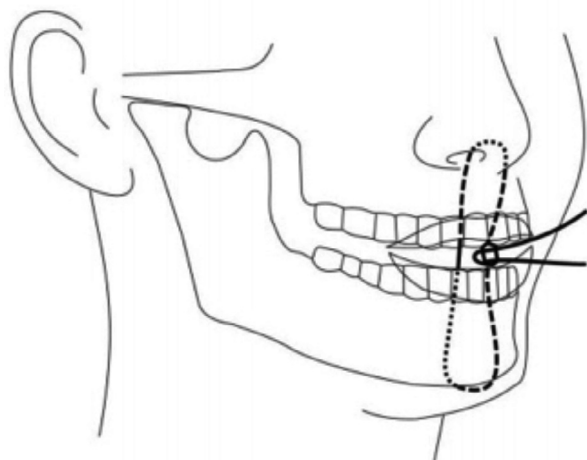


Figure 4. Internal suture to close the lips. Graphics by Jiri Tauš.

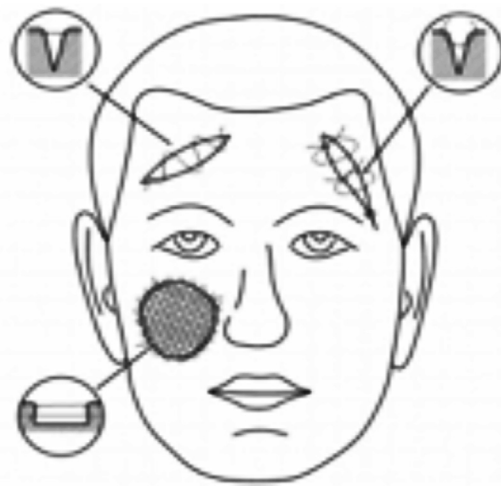


Figure 5. Possibilities of correcting soft tissue defects with various sutures and wax. Graphics by Jiri Tauš.

necessary to correct the surface of the subcutaneous tissue, it can be used by injecting a mixture of 8 parts of paraffin and 2 parts of white petroleum jelly, heated to 44 °C, followed by cooling or Celladamm 16–20%, white beeswax 55–70%, paraffin 6–19% and petroleum jelly 6–12%.<sup>[16]</sup> Bruises on the skin can be removed by wiping with special soap with a shaving brush for about one hour. Removal of swelling of facial tissues has been accomplished with anhydrous embalming with compresses. Partial drying of small skin areas, parchment-like, can be eliminated, in particular, with a solution of water, acetic acid and hydrogen peroxide. For example, to reduce the results of putrefactive processes, the head tissues could be impregnated with preservative solution via blood vessels and impregnation takes 24 hours with a solution of 750 ml of formalin, 2250 ml of deodorant, 750 ml of isopropyl alcohol, 750 ml of alaminol and up to 9000 ml of water. Then the tissues are fixed in a solution of 125 ml of formaldehyde, 1000 ml of hydrogen peroxide, 1000 ml of acetic acid, 500 ml of isopropyl alcohol, 500 ml of deodorant, 250 ml of alaminol and 10,000 ml of water.<sup>[17]</sup> This preservation procedure is performed to reduce the psychological trauma of individuals providing identification, should such procedure be required.

**Preservation of the corpse or part of it** is usually performed before reconstruction of soft tissues, before using some complex autopsy methods, at the request of relatives, for short-term storage or for shipping to temporarily prevent the development of post-mortem changes. This can be done arterially or by injecting a preservative solution into the subcutaneous tissue (**Figure 6**). For temporary preservation, a 5–10% aque-



**Figure 6.** Points of injection of the fixing solution into the subcutaneous tissue of the face. Graphics by Jiri Tauš.

ous solution of formalin with other substances is the most preferable to use.<sup>[18]</sup> Solution options: 5–10% formaldehyde solution, 50–96% alcohol, 5–10% phenol solution or 0.2–0.7% anolyte solution.<sup>[19]</sup>

**Body embalming** has been performed at the request of relatives for a funeral ceremony or in relation to the international transport to suspend decomposition processes. Either commercially produced, for example, Dodge Company, Arthyl 26 Hygeco France and others, or experimentally mixed solutions of formaldehyde, ethanol, phenol, glycerin, water and other components are used. Other solutions suggestions include:

- sublimate 10 g, formalin 100 ml, alcohol 200, water 700;
- formalin solution 150 ml, alcohol 200 ml, water 650 ml, potassium acetate 50 g;
- zinc chloride solution 50 g, formalin 100 ml, alcohol 200 ml, water 650 ml;
- solution for Vyvodtsev;
- glycerin 1700 ml, water 1000 ml, thymol 5 g (previously dissolved in alcohol);
- glycerin solution 600 ml, alcohol 200, formalin 200 ml, potassium acetate 30 g;
- solution of Melnikov-Razvedenkov;
- glycerin 200–600 ml, potassium acetate 200–800 g, water 1000 ml.<sup>[20]</sup>

Perfusion is carried out manually with a syringe, hand pump, gravity flow from a height of 2.5 m, peristaltic or embalming pump. The volume of the embalming solution is usually 7 to 14 liters. The choice of the volume and composition of the solution depends on the size of the body, the degree of post-mortem changes, the cause of death and other aspects. The most used perfusion site is through the femoral artery or the common carotid artery. It is also possible to use the ulnar, radial, brachial, or tibial arteries, etc. After arterial embalming, the openings of perfusion sites are closed with absorbent material, tissue glue and skin suture.

### Body Embalming Without Autopsy

It is performed through an intact arterial bed with venous drainage, fan-shaped aspiration of the contents of the body cavities followed by the introduction of an embalming solution or subcutaneous injection into the limbs, face or chest and abdominal cavities.

### Embalming the Body After Autopsy

Residual fluid is removed from open body cavities, limbs and head are sprayed onto the severed ends of the femoral, brachial, and common carotid arteries. The dis-

sected organs are placed in a plastic bag with a solution for embalming, sealed and inserted into the cavity. After the completion of the injection of the vessels of the limb, an additional injection of the subcutaneous tissue of the chest cavity is performed. The holes and incisions on the body are sealed and closed as described above.<sup>[21–23]</sup>

The main body restoration should be carried out properly after each autopsy to a state that most closely resembles a pre-autopsy state. A special type of restoration is performed in cases of a special opening or treatment technique, when it is necessary to fix dissected tissues or replace removed structures. In some cases, the reparation of devastating injuries is a notable success.<sup>[24]</sup> With high-quality embalming, there is no development of post-mortem changes for more than 10 days.<sup>[25]</sup> In case the embalming solution has been selected correctly, only small changes show up as very slow mild dehydration over many months.

## Conclusion and Recommendations

Although extensive body restoration is not a standard part of the forensic field, it is pertinent to know these techniques and thus improve the quality of cadaver care in order to maximise respect shown to these bodies. Most of the substances contained in embalming solutions, i.e., formaldehyde, ethanol, phenol, potassium acetate, acetic acid and others, have a sanitary effect and destroy most infectious agents. Histoacrylic adhesive can also be used to close and repair skin incisions in young children.<sup>[26–28]</sup> Knowledge about treatment and simple rules of body fixation can be easily used in forensic practice.<sup>[29,30]</sup>

## Conflict of Interest

The authors declare that there are no conflicts of interest.

## Author Contributions

JF: project development/manuscript writing, MAK: project development/data collection, MB: manuscript writing and editing, VD: data collection.

## Funding

No funding was received for this research.

## References

- Parsons MA, Start RD. ACP best practice no 164: necropsy techniques in ophthalmic pathology. *J Clin Pathol* 2001;54:417–27.
- Langlois NEL, Little D. A method for exposing the intraosseous portion of the carotid arteries and its application to forensic case work. *Am J Forensic Med Pathol* 2003;24:35–40.
- de Jonge HK, van Merkesteyn JP, Bras J. Reconstruction of the lower half of the facial skeleton after removal of the mandible at autopsy. *Int J Oral Maxillofac Surg* 1990;19:155–7.
- Frišhons J. Pitevní a preparační techniky v tělních krajinách [Autopsy and preparation techniques in body landscapes]. *Gnosis Medica* 2017;4:5–44.
- Avdeev AI. Metod kosmetičeskogo iz'jatija kostej mozgovogo cherepa. Izbrannye voprosy sudebno-medicinskoj jekspertizy [The method of cosmetic from the “bones of the cerebral skull”. Selected questions of forensic medical examination]. *Habarovsk* 2018;17:9–10.
- Frišhons J, Kislov MA, Leonov SV. Ispol'zovanie 3D-pechati v sudebnoj medicene [The use of 3D printing in forensic medicine]. *Forensic Medicine* 2018;2:10–2.
- Kopija P, Frišhons J, Joukal M. Modifikace pitvy obličeje [Facial autopsy modification]. *Gnosis Medica* 2013;1:24–7.
- Duflou J, McNamara B, Cluney R. A safer method for body restoration following autopsy. *J Forensic Sci* 2013;59:224–5.
- Joukal M, Frišhons J. A facial reconstruction and identification technique for seriously devastating head wounds. *Forensic Sci Int* 2015;252:82–6.
- Leonov SV, Vlasjuk IV. Restavracija vneshnej trubny. Habarovsk, Izdatel'stvo DvGMU, editors. In: Body surface restoration (practical guide). Khabarovsk; Dvgtu Publishing. 2008.
- Frišhons J, Hejna P, Leonov SV, Vojtišek T, Krajsa J, Stoklásková K, Rambousek P, Zeman M. Přehled postmortálních technik pro případy rekonstrukce mutilujících poranění obličeje [An overview of postmortem techniques for the reconstruction of mutilating facial injuries]. *Criminal Proceedings* 2018;62:49–59.
- Kladov SJu. Posmertnaja restavracija lica. Pohoronnyj dom: rossijskij informacion noanaliticheskij [Postmortem face restoration. Funeral Home: Russian information]. *Journal of Novosibirsk* 2006; 11:44–7.
- Namestnikova JuG. Restavracija lica trupa dlja celi ego opoznanija [Restoration of the face of the body for the whole ego acquaintance]. *The Doctor* 1948;1:63–6.
- Cin'kovskij BP. K vopros o tualeta i restavracija trupov [To the question of the toilet and the restoration of corpses] Collection of Scientific State Vinnik 1956;2:187–94.
- Sal'kov AA. Iskusstvennoe ozhivlenie trupa neizvestnoj lichnosti s cel'ju ee opoznanija [Artificial revival of the corpse of an unknown person in order to identify it] *Forensic Medical Examination* 1928;7: 54–61.
- Abramov I. Restavracionnaja plasticheskaja massa [Restorative plastic mass]. 2006; Patent RF No: 2576820 C1.
- Buromskij IV, et. al. Sposob ustanovlenija prochnogo karkasa V sostojanii gnilostnogo razlozhenija. Patent RF # 2390997. Obshhestvo s ogranichennoj otvetstvennost'ju “KB-Centr” [Method of establishing a strong frame in a state of putrefactive decomposition. RF patent # 2390997. KB-Center limited liability company]. 2010.
- Kuznecov LE. Bal'zamirovanie i restavracija trupov [Embalming and restoration of corpses] *Medicine* 1999; 496 p.
- Didenko AS, Smirenin SA, Vorob'ev AA. Bal'zamirovanie trupov v uslovijah sovremennyh lokal'nyh vooruzhennyh konfliktov [Embalming of corpses in the conditions of modern local armed conflicts]. *Epic Class Fighter Journal* 2004;14:16–9.
- Medvedev II. Osnovy patologoanatomicheskoi tehniki. [Fundamentals of pathological and anatomical technique. A guide for hospital prospectors and medical students.] 3rd ed. Moscow: M. Medicine; 1969. 288p.
- Ikeda K. Preparation of the autopsied body for embalming. *American Journal of Clinical Pathology* 1938;2-4:127–34.

22. Williams HW, Henderson DG. Restoration of autopsied bodies. *N Engl J Med* 1934;211:371.
23. Peasley ED. A method for restoring the body after autopsy. *JAMA* 1936;107:1378-9.
24. Krupin KN, Frishons Y, Kislov MA. Method of determining the corpse face's appearance to the life form. *Russian Journal of Forensic Medicine* 2018;4:28-31.
25. Golushko VP, Mazevskej VI, Anin JA. Osobnosti metodicheskogo podhoda k bal'zamirovaniju tel umersih na dlitel'nyj srok [Features of the methodological approach to embalming the bodies of the deceased for a long time]. *Journal of the GrSMU* 2008;4:133-5.
26. Harris MD. Reconstruction of fetuses after dissection. *J Clin Pathol* 1992;45:90.
27. Mott C, Chambers HM. Repair of fetal bodies after dissection. *J Clin Pathol* 1992;45:183.
28. Gau GS, Napier K, Bhundia J. Use of a tissue adhesive to repair fetal bodies after dissection. *J Clin Pathol* 1991;44:759-60.
29. Donlon S, Ruddy GN. Reconstruction of the body. In: Burton JL, Ruddy GN, editors. *The hospital autopsy*. 3rd ed. London, UK: HodderArnold; 2010. p. 308-14.
30. Frishons J, Strnad A, Rambousek P. Zachovat těla zemřelých [Preserve the bodies of the dead]. *Universe* 2020;10:2-5.

**ORCID ID:**

J. Frišhons 0000-0003-2998-2602;  
 M. A. Kislov 0000-0002-9303-7640;  
 M. Bezdickova 0000-0002-5798-4528;  
 V. Dzetkucicová 0000-0001-8545-6864

**Correspondence to:** Marcela Bezdickova, MD

Department of Anatomy, Swansea University Medical School,  
 Swansea, SA2 8PP, Wales, UK  
 Phone: +44 798 5441983  
 e-mail: marcela.bezdickova@swansea.ac.uk

*Conflict of interest statement:* No conflicts declared.

This is an open access article distributed under the terms of the Creative Commons Attribution-NonCommercial-NoDerivs 4.0 Unported (CC BY-NC-ND4.0) Licence (<http://creativecommons.org/licenses/by-nc-nd/4.0/>) which permits unrestricted noncommercial use, distribution, and reproduction in any medium, provided the original work is properly cited. *How to cite this article:* Frišhons J, Kislov MA, Bezdickova M, Dzetkucicová V. Notes on the techniques of body restoration after autopsy and the possibility of embalming. *Anatomy* 2022;16(2):108-113.