Short Report: Museum

Restoration activities for the enhancement of the anatomical collections of the Pavia University Museum System

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Abstract

Aim. The restoration activities carried out on the anatomical collections of the Pavia University Museum System are presented. These anatomical preparations dates back to 1772, with anatomist Giacomo Rezia, and was subsequently enriched by Antonio Scarpa, Bartolomeo Panizza, Giovanni Zoja, and others. In the 1930s the human anatomy collections were transferred to the new medical institutes in Via Forlanini and recently named after anatomist Luigi Cattaneo, while some anatomical specimens were chosen for the Pavia University History Museum. The collections testify to discoveries and turning points in the history of science and show how teaching anatomy to future doctors and surgeons required a huge effort in the preparation and setting of pieces, both dry and wet, that would allow the transferring of anatomical and surgical knowledge.

Material and Methods. In 2016 the restoration activities of anatomical preparations began to stop their physiological degradation. For each preparation, all the information regarding the storage conditions and past restoration operations was collected; accurate photographic documentation was carried out, to make every intervention traceable. The interventions were strictly conservative, aimed at preserving the specimens as they were originally prepared and improving their general conditions of conservation. The restoration was authorized by the Superintendence of Archeology, Fine Arts and Landscape. To date, 366 dry-preserved anatomical preparations and 58 liquid-preserved anatomical preparations have been successfully restored.

Results. The restoration made it possible to efficiently recover precious finds from the University Museum System of the University of Pavia, without altering any element that could provide historical information on the pieces in question, avoiding the replacement or alteration of each component of the find that could provide indirect information regarding the preparation technique, the preparer, and the date of realization. Furthermore, in order not to invalidate future paleopathological studies, particular attention was paid not to alter signs of pathologies or trauma and not to use aggressive solvents, in order to protect the integrity of the DNA for genetic or molecular analysis.

Discussion and Conclusion. The conservative restoration conducted allowed to renew the scientific usability of such valuable biological preparations, making them, still nowadays, a useful tool for educational purposes in university anatomy courses.

Key words: anatomical collections, conservative restoration, medical collections, dry collections, wet collections

Introduction

The anatomical collection of the Pavia University Museum System dates back to 1772, with anatomist Giacomo Rezia (1745-1825), and was subsequently enriched by Antonio Scarpa (1752-1832), Bartolomeo Panizza (1785-1867) and Giovanni Zoja (1832-1899) (Dubini, 1837; Monza, 2006; Garbarino, 2014; Garbarino, 2020). Towards the end of the 19th century, the Normal Human Anatomy Collection was transferred to a new location, in Palazzo Botta, an ancient noble residence acquired by the University of Pavia for its scientific institutes. The collection was moved again in the '30s of the past century in the new buildings of the Medicine Faculty, in Via Forlanini. Scarpa's Museum also preserved a Pathological Human Anatomy Collection, which was enormously increased from 1855 by Giacomo Sangalli (1821-1897) with exemplary pieces and autopsy examination protocols, so much so that the assignment of new premises was soon necessary.

Some anatomical preparations can be linked to clinical records or autopsy reports. It is therefore possible to examine biographical and clinical information of great interest, which however, opens up some ethical problems relating to exhibiting such pieces. This collection was eventually moved to the building in Via Forlanini in the '30s, leaving the rooms that had once housed Scarpa's Collection.

In the same years, the Pavia University History Museum was founded; anatomical pieces of particular interest were selected for its displays, from the two collections that had found in Via Forlanini their new home (Monza & Poggi, 2003; Falomo et al., 2020).

The collection in Via Forlanini, named after anatomist Luigi Cattaneo, consists nowadays of more than 2000 finds, including anatomical preparations, models, and wax sculptures, dating back to the late 18th and late 19th centuries. The collection is divided into different sections: Osteology, with various types of preparations, from infants to adults, and a rich collection of skulls, including the one belonging to scientist Valentino Brugnatelli (1761-1818); the Angiology section with dry prepared whole cadavers, as well as a series of preparations relating to the heart and venous, arterial and lymphatic systems; the section of Embryology with embryos, human fetuses, and gestating uteri; the section of General Anatomy with fine preparations relating to connective, cartilage, and bone tissue, preparations of muscle, nervous tissue, and blood vessels; and the sections of Splanchnology, Estesiology, Neurology and Topographical Anatomy.

The Medicine section of the Pavia University History Museum includes instruments, memorabilia and anatomical preparations relating to the second half of the 1700s, to the 1800s and to the 1900s. Among these is also the anatomical and pathological collection of a museum founded inside the S. Matteo Hospital by surgeon Luigi Porta (1800-1875), pupil of Scarpa (Garbarino, 2016).

To stop their physiological degradation, restoration activities of anatomical preparations began in 2016 (Restivo et al., 2019). All the information regarding storage conditions and past restoration operations was collected for each preparation; accurate photographic documentation was carried out, to make every intervention traceable.

Materials and e Methods

The restoration of the 'Luigi Cattaneo' Collection (Institute of Human Anatomy)

The restoration, authorized by the Superintendence of Archeology, Fine Arts and Landscape, involved four full-length myological statues, significant and very complex anatomical preparations that presented a fairly critical conservation situation. By comparing the identification tags, in some cases incomplete, with the historical inventories of the Anatomical Museum, a good number of information relating to these precious preparations was collected. They are described in the angiology section of the catalog published by Giovanni Zoja (1889): they are myo-arterial preparations of the corpses of a 7-year-old boy (E4) and a 13-year-old boy (E3), attributed to Panizza. The third statue is also ascribable to him and is identifiable with the number E2 based on the description provided by Zoja: "Dry preparation of the whole arterial and muscular system of an adult, for which care was taken to leave, on the right side, the arteries in their relations with the superficial parts, whereas on the left side the deeper arterial ramification

where left exposed" (Zoja, 1899). The fourth statue is accompanied by a tag with the number 136 and seems to have been prepared by Scarpa, instead: an adult man, with emphasis placed on major arteries and veins with their ramifications. The muscles are accurately highlighted, and in some cases artificially enlarged. The biological preparations have undergone thorough cleaning and repair, with a preference for the less invasive restoration techniques - agreed upon with the staff in charge of the collections - and with the highest regard for the historical value of the pieces.

The considerable dimensions of the preparations, together with their complexity and fragility, made the operations for both transport and restoration quite elaborate. The four preparations were taken from the displays and moved to a laboratory especially set up for the occasion inside of the same building. Any damages detected on the samples were marked on a dedicated restoration record card, together with notes on the state of conservation. Tags and labels were photographed, and the contents were transcribed, when readable; ultraviolet light was also employed to verify the presence of characters and numbers that might have lost pigment and might therefore have become invisible to the naked eye. A general cleaning and disinfection of the pieces followed. During a first stage, dust and dirt deposits were removed, using a controlled flow of low pressure compressed air and soft-bristle brushes. Afterwards, a deep clean of the preparation and of its base was carried out, manually removing any dirt adhering to the surface by wetting and dabbing with a solution of H_2O and benzalkonium chloride 10 %, which also performs a disinfecting action (Fig. 1). The tissues presenting with mold were treated with denatured hexane or with a solution of H_2O and benzalkonium chloride 10 %, according to their frailty. Wherever the shellac was irreversibly deteriorated or altered, it was necessary to remove it by delicately dabbing it with 95° alcohol. After cleaning, a thin layer of shellac was applied to protect the tissues and to restore their original lacquered appearance. Repairs relating to the breakage of tendons, nerves and blood vessels were carried out with mechanical techniques (binding etc.) or with chemical ones (gluing). Gluing was achieved with an acetovinyl homopolymer dispersed in water at different solutions, to ensure that the process be reversible. Finally, a detailed photographic documentation of every piece that underwent restoration was produced both before, during and after the process (Fig. 2, 3 and 4).

Figure 1. Deep clean of the preparation is carried out, manually removing any dirt adhering to the surface by wetting and dabbing.

The restoration of the collection of the Pavia University History Museum

The restoration of the dry biological preparations followed the same intervention protocol used for operations on the "Luigi Cattaneo" collection, accounting of course for necessary differences. For the restoration of preparations preserved in liquid, the protocol required the preliminary analysis of the state of conservation of each piece in its entirety, meaning: the biological sample, the preserving solutions -which develops a chemical balance with the biological sample- and the original glass vase with its tag, both rich in useful historical and scientific information. According to any critical issues emerging on any of the three elements (biological sample, solution, and vase), a series of specific operations apt to recover each of them is put into action.

Figure 2. Myological statue E2 before (a) and after (b) the restoration.

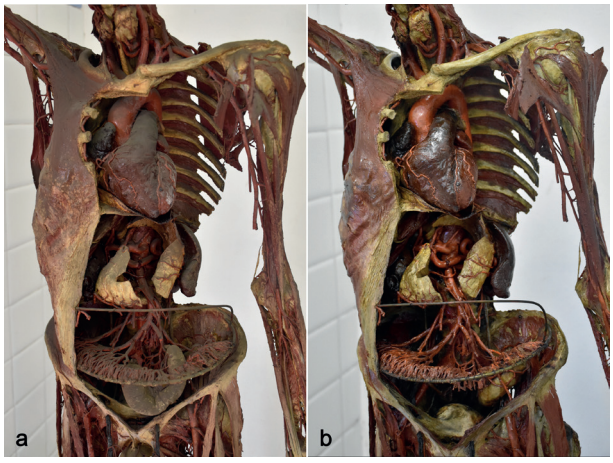

Figure 3. Detail of the myological statue E2 before (a) and after (b) the restoration.

As for the procedure reserved for the glass vases, the closure of the lid of each container is verified before the cleaning phase, as well as the integrity of all the components: vase, lid, lid-ring (pig bladder or parchment of animal origin) and the state of the external sealant (black sealing wax or shellac), when present. After the analysis, the external surface of the container is thoroughly cleaned, with products specifically

Figure 4. Details of the myological statue E3 before (a, c) and after (b, d) the restoration.

intended for glass cleaning and solvents suitable for the other parts. In a few cases, the lid had to be replaced (being broken or not fitting) with a new glass disk bearing a sandpapered lower side.

For the operations concerning the solutions, its quantity present in the vase and its state of alteration was evaluated by visual examination; the type of solution was then verified and proven to be formalin in all cases except one. The pH was determined with indicator papers with different sensitivities. Where necessary, the liquid was topped up with 4% buffered formalin. Only when the quantity of liquid in the vase was extremely low, it was substituted, particularly if it was visibly altered. Lastly, when the liquid was not present at all, but the biological sample was not entirely dried out, the solution was restored with 4% buffered formalin. To further increase the data available on the collection, where possible, a sample of the liquid was drawn to allow future analysis. The biological samples have been carefully examined to determine the presence of mould or any breakage of the tissues. Where necessary, the preparations were removed from the vase, cleaned from any residue of altered liquid or salts, and placed back inside the cleaned vase. In some

cases, it was necessary to tie the biological sample back to its supports to restore the original setting. The containers were then newly sealed with different methods, considering the type of lid and the content of the vase. The lid and the mouth of the container were covered with a sheet made of pig bladder, tied by hand with waxed twine, on which a layer of black sealing wax dissolved in ethyl alcohol was applied (Fig. 5) (Gestro, 1925; Zangheri, 1969; Naj et al., 2019; Restivo et al., 2019). Besides securing the airtight closure of the vase and bettering its state of preservation long term, this last operation intensifies the ostensive value of the preparation.

Where necessary, a delicate superficial cleaning of the original tags was carried out, whereas any partially detached one were attached again to the vase.

Figure 5. Application of black sealing wax dissolved in alcohol.

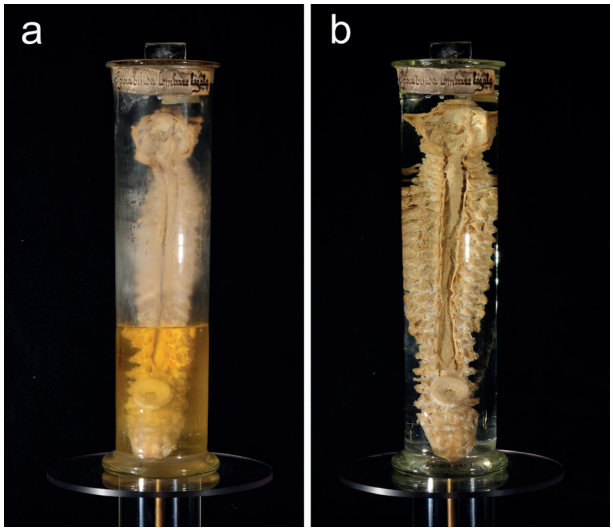

Figure 6. Specimen no. 824, example of an anatomical preparation preserved in liquid before (a) and after (b) the restoration.

Results

The restoration made it possible to efficiently recover precious finds from the University Museum System of the University of Pavia, without altering any element that could provide historical information on the pieces in question, for example avoiding, the replacement or alteration of nails, bindings, original supports or labels and, more generally, of each component of the find that could provide indirect information regarding the preparation technique, the preparer and the date of realization. Furthermore, in order not to invalidate future paleopathological studies, particular attention was paid not to alter signs of pathologies or trauma and not to use aggressive solvents, in order to protect the integrity of the DNA for genetic or molecular analysis.

The interventions were strictly conservative, aimed at preserving the specimens as they were originally prepared and improving their general conditions of conservation. To date, 366 dry-preserved anatomical preparations and 58 liquid-preserved anatomical preparations have been successfully restored (Fig. 6). Particularly worth mentioning among the restored preparations, aside the four myological statues, is the common torpedo or electric ray fish preserved in formaline in the room dedicated to Alessandro Volta (1754-1827) (Bellodi et al., 2002), Antonio Scarpa's head, preserved in alcohol (Cani & Garbarino, 2017; Garbarino & Cani, 2018), and the skeleton of a man called Luigi Cella, who was known as the "dwarf of the bridge", one of the preparations with the most dramatic story. Affected with dwarfism, Cella was a beggar who lived most of his live asking for alms near the covered bridge on the Ticino river, singing and playing a mandolin to entice by-passers to donate. He was extremely well known in Pavia in the mid-18th century and he was portrayed, among others, by painter Ezechiele Acerbi in the wooden frame of a view of Pavia (preserved at the Pavia Civic Museums). In 1843, newspaper Gazzetta della Provincia di Pavia reported

the news of the lithography, found "in the display of some shop", which represented "a most renown man to anyone who visits the streets or the cafes of Pavia: who in others times would have been sitting at the most sumptuous banquets of Kings, but nowadays lives on charity by touching, the best he can, the strings of a guitar" (Bernardi et al., soon to be published). Cella died in 1872 at San Matteo Hospital in Pavia, at the age of sixty-six. Giacomo Sangalli conducted a thorough autopsy on the body and the skeleton was prepared for the Pathological Anatomy Museum, of which Sangalli was the director.

Conclusion

The anatomical collections are extremely valuable to gain an understanding of the complexity of the human body but also of the meticulous and difficult work of the scholars who, through the centuries, were able to describe increasingly accurately the human structure, both in normal and pathological conditions. The collections testify to discoveries and turning points in the history of science, but also to errors and sufferings due, on the one hand, to the impact that illness has always had on the human condition, and on the other, to social circumstances that affected particularly the most fragile (Mazzarello, 2015).

The Pavia collections furthermore show how teaching anatomy to future doctors and surgeons required a huge effort in the preparation and setting of pieces, both dry and in liquid, that would allow the transferring of anatomical and surgical knowledge.

The conservative restoration conducted allowed to stop the deterioration that was developing and to renew the scientific usability of such valuable biological preparations, making them, still nowadays, a useful tool for educational purposes in university anatomy courses (Garbarino et al. 2020; Falomo Bernarduzzi et al., 2021).

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