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CASE REPORT

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Titian's Secret: Comparison of Eleonora Gonzaga della Rovere's Skull with the Uffizi Portrait

ABSTRACT: The present paper describes the study of a skeleton, kept at the Church of Santa Chiara in Urbino, Italy. Traditionally, this skeleton was thought to be that of the Duchess Eleonora Gonzaga della Rovere (1493–1550), but suspicion exists as to whether or not the remains might belong to another important personage of the Urbino Renaissance, Battista Sforza (1447–1472). Here, external observation of the skull and odontological examination of the mandible were conducted in an attempt to clarify the identity. Age estimates of the skeleton were found to be consistent with the age at death of Eleonora but not with that of Battista. Craniofacial superimposition using the portrait of Eleonora Gonzaga by Titian (Galleria degli Uffizi, Florence) shows that the face of Eleonora matches the skull fairly closely except for the length of the nose. The historical record and the age matching appear to provide strong evidence that the remains are those of Eleonora, and the discrepancies in the superimposition may suggest that the artist altered the dimension of the Duchess' nose, possibly to make the portrait correspond to his canons of classical beauty. The results highlight the potential of forensic methods as a key to understand the work of earlier painters.

KEYWORDS: forensic analysis of art, craniofacial superimposition, forensic odontology, age at death, Titian, Renaissance portrait

The church of Santa Chiara at Urbino (Marches, Central Italy) was for almost one century the last resting place of some members of the della Rovere family (one of the most prominent families of the Italian Renaissance), namely of the Duke Francesco Maria I (1490–1538), his wife Eleonora Gonzaga (1493–1550), the Duchess Giulia Varano (1524–1547) and the Cardinal Giulio Feltrio (1533–1598). Originally, their wooden sarcophagi were kept in the choir of the church until, in 1633, they were moved to the cloister. On that occasion, the four bodies, which were mummified and enveloped in their funerary clothing, were accurately described by an eyewitness (1). In 1872, as reported by Pompeo Gherardi (2); the original coffins were found to be extensively damaged and the corpses fully skeletonized, although the clothing was still preserved. For this reason, the bottom of the coffins (with the remains on them) were lifted out and fitted into new containers. The new coffins were labeled with the name of the relevant personage painted on the lid and on one side. Explorations conducted by the Marchean Superintendency of History and Fine Arts at the end of 1990's led to the finding of the remains in a crypt where they had lain since 1872. One coffin, in particular (Fig. 1), labeled with the inscription "*Leonora Gonzaga uxor F.M. ducis*" (Eleonora Gonzaga wife of the Duke Francesco Maria) was found to contain a female skeleton dressed with clothing that closely corresponded to the 1633 document (Fig. 2):

> "She was dressed in a black cloth, in addition, folds and bands of the finest white veil hung from her head till her feet which were without shoes. A bandage passed under her chin and was fastened in the middle of the head which was additionally adorned with some yellow veils."

All this offered strong support for identifying the personage with the above-cited Duchess Eleonora Gonzaga della Rovere. However, there was the suspicion that also a further important female personage of the Urbino Renaissance might have been buried in the Church. This was Battista Sforza, wife of the Duke Federico da Montefeltro (1422–1482). This lady died in 1472 at the age of only 25 years. The suspicion was manly based on ancient chronicles (3) reporting her last words to her husband:

> "... I commend you my soul and I pray you to lay this perishable body in the sepulchre of my nuns of Santa Chiara in Urbino."

Apart from this indication, nothing is known about the fate of the remains of Battista. In particular, she is not mentioned in the 1633 report (1). While in addition, there are other documents suggesting that she was actually buried in the Montefeltro family mausoleum on San Bernardino hill, near Urbino (3).

In July 2003, the present Authors were invited by Maria Giannatiempo, of the above-cited Superintendency, to examine the remains of "Leonora" and see whether there could be any biological ground for attributing them to Battista Sforza instead of Eleonora Gonzaga. As the age at death of the two personages was rather different (56 years Eleonora, 25 Battista), our study was aimed at determining the biological age of "Leonora" using anthropologic and odontological methods.

In addition, the study offered a chance to use forensic methods to investigate an intriguing theme: the likeness of a Renaissance portrait. This was rendered possible by the fact that virtually all

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FIG. 1—*The XIX century wooden coffin with the Latin inscription Leonora Gonzaga uxor F.M. ducis ("Eleonora Gonzaga wife of the Duke Francesco Maria").*

FIG. 2—*The purported remains of Eleonora Gonzaga della Rovere. Note, in particular, the strip of veil on the left (white arrowhead) and, on the right, the remains of the bandage that originally passed under the chin, still fastened to the headgear (black arrowhead).*

the most prominent personages of the court of Urbino had sat for portraits by famous artists such as Raffaello Sanzio ("Raphael"), Piero della Francesca, and Tiziano Vecellio ("Titian").

Methods

The inspections (one in July 2003 and one in September 2004) were necessarily limited to external observations and use of a digital camera and a 3D digitizer to comply with the desire of the Superintendency officials that the remains should be disturbed as little as possible, in particular the well-preserved clothing. We were nevertheless allowed to temporarily remove the mandible for a more accurate odontological examination and keep a tooth root for further radiological analysis.

Biological Age

Age at death was estimated on the basis of the observation of the ectocranial lateral-anterior sutures (4), the state of the dentition (5) and its degree of wear (6,7). We also employed a recently developed method (8) for age determination of adults from single-rooted teeth. This is based on the observation that the pulp reduces at a fairly constant rate by apposition of secondary dentin on the walls of the cavity. It has been demonstrated that there is a linear relationship between pulp/root width at mid-root level and pulp/root area, on the one hand, and chronological age, on the other. Practically, the root is radiographed and the image processed using a computer-aided drafting program (AutoCAD2000, Install Shield 3.0, 1997). Twenty points from the tooth outline are identified and used to evaluate tooth and pulp areas. The age is then estimated on the basis of the following linear regression formula:

$$\text{Age} = 86.53 - 457.15\text{AR} - 22.98\text{c}$$

where AR indicates the pulp/root area ratio and c the pulp/root width at mid-root level.

In our case, the radiological analysis was performed at a Philips Oralix 65 instrument (70 kV, 8 mA) using Agfa slides.

Superimposition Analysis

The remains were photographed from different angles using a digital camera (Canon EOS 300D) mounted on a tripod and connected to a portable computer (Hewlett-Packard Pavillon).

Tri-dimensional scanning was performed by a Minolta VIVID 700 3D digitizer mounted on a tripod. This digitizer works on the principle of optical triangulation (9). The different operations of data registration, integration, model conversion, and visualization were performed using Polygon Editing Tool software.

Digital pictures either obtained by the digital camera or the 3D digitizer, were superimposed on the portrait using Adobe Photoshop 2.0. The picture of the skull was pasted onto that of the portrait and its opacity reduced to 50% of the original. At this point, the dimensions of the skull were modified, keeping their relative proportion constant, to fit the portrait.

Best fit was obtained in two ways: 1) at the site, using the digital camera, by repeating the shot from different angles until a satisfactory fit was obtained; 2) in the laboratory, by rotating the 3D model in space using the above-cited software.

Superimpositions were checked using the requirements for consistent fit between skull and face proposed by Austin-Smith and Maples (10). We utilized the twelve comparison elements for frontal view and an additional thirteenth one taken from the lateral view table and pertaining to the position of the auditory meatus with respect to the ear (point no. 8 in the Austin-Smith and Maples paper). On the other hand, we could not make use of dowels inserted in the auditory meatuses of the skull or of depth markers because, as reported above, we were not given permission to manipulate the remains.

FIG. 3—*The mandible, posterior view, to show the state of dentition. Note, in particular, the partial edentuly of the horizontal ramus and the advanced wear of the only molar (M_1) remaining.*

Results

Estimation of Biological Age

The examination of the calvarium showed a complete obliteration of the lateral-anterior sutures. This corresponds to an age at death of $\geq 56 \pm 8.5$ years (4).

Further indications were obtained by examining the state of the dentition. It was observed that while the upper dentition, as far as one could judge, was essentially preserved, the mandible was partially edentulous, with the sole tooth surviving from the rear group being the left first molar (Fig. 3). Signs of abrasion were observed on the necks of all teeth. The crown of the above-mentioned first molar, in particular, was markedly worn. These observations are consistent with a relatively advanced age of the subject (5,6).

This estimation could be further refined by using the method of Li and Ji (7), which divides the degree of wear of the dentition (first and second molars) into nine stages. The age at death is then calculated using the following formula:

$$\text{Age} = 11.42 + 6.32\ M_1$$

In this case, the value attributed to M_1 was 7.5 which gives a value of 58 ± 3.6 years.

In addition, we were able to take advantage of the availability of a canine tooth root to use a newly developed method (8) as reported in the Methods section. Once this method was applied to the tooth root found in the coffin, it gave an age at death of approximately 56 ± 5 years.

Craniofacial Superimposition

Once the osteological and odontological examinations were completed, the skull of "Leonora" was superimposed on the Uffizi portrait of Eleonora Gonzaga by Titian (Fig. 4) as reported in the Methods section. It seems important to remark that the identification of the sitter of the Uffizi portrait has always been undisputed (11,12). The analyses were performed using either 2D digital stills (Fig. 5) or a virtual 3D model (Fig. 6). The latter, in particular, was employed to check the fit using the method of the split face. Best fit was obtained with the 3D skull model approximately oriented on the Frankfurt plane and rotated rightwards by about 30°. The

FIG. 4—*The portrait of Eleonora Gonzaga Della Rovere by Titian (oil on canvas 1.14 × 1.03 m).*

FIG. 5—*Superimposition of a 2D digital still on the portrait.*

superimpositions were then scrutinized (Table 2) following the rules for consistent fit between skull and face (10).

One can observe that skull and face fit in many details, such as shape of the forehead and the mandible, distance between the

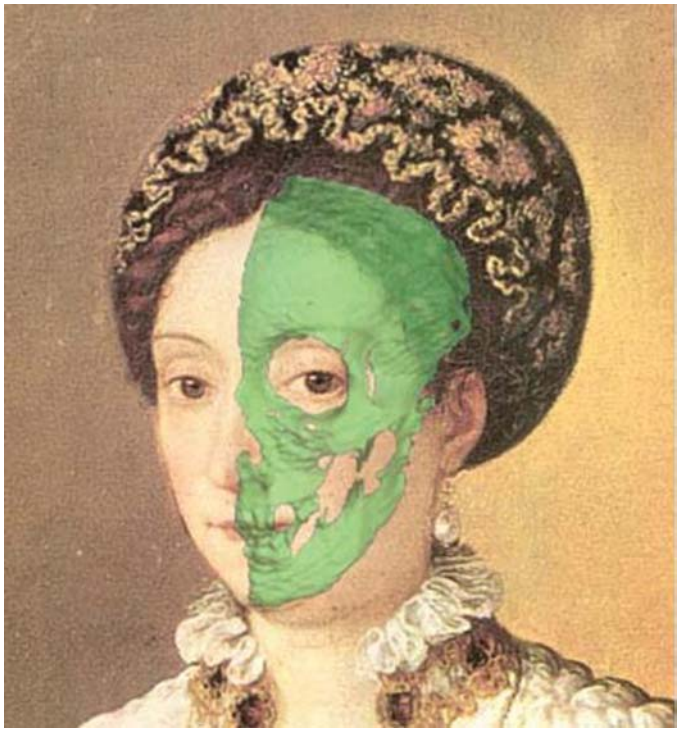

FIG. 6—*Split-face comparison using the 3D model of the skull.*

cheekbones, positioning of the eyes within the orbits and of the lips with respect to the front teeth. Actually, 10 out of the 12 comparison elements utilized are found to fit, while the fit is uncertain for two elements pertaining to the position of the auditory meatus with respect to the ear (Table 2). On the other hand, though the nasal aperture with respect to the nose obeys the two relevant rules ("9: the width and length of the nasal aperture falls inside the borders of the nose; 10: the anterior nasal spine lies superior to the inferior border of the medial crus of the nose"), it is evident that the length of the nose in the portrait is exaggerated. We calculated that, once transposed to the proportions of the canvas, the *alae* are positioned approximately 15 mm below the inferior border of the nasal aperture in a total face length (trichion to gnathion) of approximately 182 mm.

Discussion

Biological Age

The results of the craniological and odontological studies fit rather well with the age at death of Eleonora Gonzaga (56 years) and, conversely, do not fit with that of Battista Sforza (25 years). This makes it unlikely that the skeleton belongs to the latter personage.

Craniofacial Superimposition

In normal forensic practice, a known effigy is used to help in identification of an unknown skull. The fact that, in the present study, the reference effigy is a Renaissance painting, instead of a modern picture, significantly changes the terms and the aim of the comparison. In this study, the skull is used to better understand how the effigy was made. To better explain this concept, a few considerations on Renaissance portraits may be useful.

The image of the painter with easel and palette standing in front of the sitter is a stereotype. Actually, at least till the XVII century, very few portraits were done in such a direct way. Very seldom were the clients available to the painter for long and repeated sittings. The practice of painting was intended as a judicious elaboration of the stimula given by observation of life rather than a straight and direct representation of it. In earlier painting, even the apparently most lifelike works never represented life, but were rather done in the quiet of the studio utilizing all the adjustments and tricks which were part of the painter's technical repertoire. The meeting between painter and patron, in the case of the portrait, gave the former the opportunity to prepare an as accurate and lifelike drawing as possible, which was subsequently re-interpreted during its transposition into a painting. Unfortunately, these sketches are extremely rare to find, as they were normally disposed of after use. Thanks to the few left, however, we can understand how the Renaissance portrait was based on a subtle balance between realism and idealisation. This was obtained by small alterations of the features, expression, gait, and clothes (13).

In addition to the capacity and inspiration of the artist, there could be reasons why the natural proportions of a personage became modified in a portrait:

- The artist and the sitter could not meet
- The portrait was posthumous.

TABLE 1—*Chronological list of the main events relative to the Della Rovere remains.*

XVI century	The mortal remains of Duke Francesco Maria I Della Rovere (†1538), his wife Eleonora Gonzaga (†1550), Duchess Giulia da Varano (†1547) and Cardinal Giulio Feltrio (†1578) are laid in the Church of Santa Chiara in Urbino.
End of XVI century-early XVII century	The four sarcophagi are occasionally opened. The bodies are seen mummified and dressed in their clothing, as reported, many years later, by an eyewitness, the Poor Clare nun, Gabriella da Pesaro.
April–August 1633	At an official inspection, the corpses are still perfectly recognisable: "The Duchess Leonora Gonzaga was seen with the mouth open with no part of the face being damaged. Some rouge made her look as if she had been dead for a few days only." The painter Gerolamo Cialdieri is given the appointment to depict the body and clothes of Duke Francesco Maria I.
1872	The sarcophagi are found to be decayed and the bodies skeletonized. The remains are transferred into new coffins.
1997–1999	The XIX century coffins are discovered in a crypt under the Church of Santa Chiara. A fifth coffin with the remains of an unknown child, "Lavinia," is also found. With the sole exception of the one labelled "Leonora Gonzaga," the coffins contain very incomplete skeletal remains, yet the cloths are exceptionally well preserved.
July–September 2001	Following restoration, the sumptuous silk cloth of Giulia Varano is exposed to the public during an exhibition in Camerino.
2003–2004	Present investigation.

TABLE 2—*Comparative examen of the skull of "Leonora" and the portrait of Eleonora Gonzaga by Titian, following the rules for consistent fit between skull and face proposed by Austin-Smith and Maples (1994).*

No.	Relationship between Specific Bone Areas and Surrounding Soft Tissues	Result*
1	The length of the skull from bregma to menton fits with the face. Bregma is usually covered with hair	+
2	The width of the cranium covers the forehead area of the face	+
3	The temporal line can sometimes be distinguished [in the photograph]. If so, the line of the skull corresponds to the line seen on the face	n.t.
4	The eyebrow generally follows the upper edge of the orbit over the medial two-thirds. At the lateral superior one-third of the orbit the eyebrow continues horizontally as the orbital rim begins to curve inferiorly	+
5	The orbits completely encase the eye including the medial and lateral folds	+
6	The lacrimal groove can sometimes be distinguished. If so, the groove observable on the bone aligns with the groove seen on the face	+
7	The breadth of the nasal bridge on the cranium and surrounding soft tissue is similar	+
8	The external auditory meatus opening lies medial to the tragus of the ear.	+/−
9	The width and length of the nasal aperture falls inside the borders of the nose	+**
10	The anterior nasal spine lies superior to the inferior border of the medial crus of the nose	+**
11	The oblique line of the mandible (between the buccinator and the masseter muscles) is sometimes visible on the face. The line of the mandible corresponds to the line of the face	+
12	The curve of the mandible is similar to that of the facial jaw. At no point does the bone appear to project from the flesh	+
13	The porion aligns just posterior to the tragus, slightly inferior to the crus of the helix	+/−

* +, Match found; +/−, uncertain match; −, match not found; n.t., not tested.
** See text.

In the case of the portrait of Eleonora Gonzaga, it is known that Titian started work on it during autumn-winter 1536–37 at the same time as that on Eleonora's husband, Francesco Maria I della Rovere, Duke of Urbino. Then in his fifties, Titian had already attained considerable fame. In 1530, he had been called to Bologna to execute the portrait of the recently crowned Habsburg Emperor of the Holy Roman Empire, Charles V. A few years later (1533), the same Charles V created him Palatine Count and Knight of the Golden Spur. By 1538 the portraits of the Dukes of Urbino were completed. In the case of Eleonora, the painter apparently had the opportunity to have the sitter available for a relatively long time, as, during autumn-winter 1536–37, the Duchess moved from Pesaro, the seat of the court, to Venice, where Titian had his studio (14).

Neither of the above-cited circumstances (the artist and the sitter could not meet; the portrait was posthumous) seems to apply to this portrait. Despite this, the craniofacial superimposition shows a discrepancy in the length of the nose and the corresponding pyriform aperture. Actually, one could object that in order to obtain a good fit, the portrayed person should smile in order to show the front teeth (10). This, unfortunately, is never the case with the Renaissance portraits of upper class personages. We can, on the other hand, remark that a slight translation downwards of the skull would be insufficient to make the nose match with the nasal aperture.

In an attempt to shed some light on the significance of this physiognomic alteration, we calculated the average anthropometric proportions for six idealized female personages painted by Titian in the years 1514–1555, namely, *Sacred and profane love* (Galleria Borghese, Rome), *Flora* (Galleria degli Uffizi, Florence), *Salomè* (Galleria Doria Pamphili, Rome), *Venus of Urbino* (Galleria degli Uffizi, Florence) *La Bella* (Palazzo Pitti, Florence), *Venus with the mirror* (National Art Gallery, Washington) and compared them with the original portrait of Eleonora, and with the same portrait modified in order to adapt the length of the nose to the nasal aperture (Table 3). It can be observed that the relative proportions (forehead; nose; upper lip and philtrum; lower lip and chin) of the original Eleonora Gonzaga are very close to the average proportions of the idealized figures. This is not the case of the modified portrait that differs in a marked reduction in the length of the nose and a corresponding increase of the philtrum and upper lip length.

TABLE 3—*Comparison of the portrait of Eleonora Gonzaga with the average proportions of 6 female figures painted in the years 1514–1555.*

No.	Anthropometrical Measure	Average Proportions*	Eleonora Gonzaga (Original)	Eleonora Gonzaga (Modified)
1	Trichion-nasion (forehead length)	38.0 (36.6–40.9)**	37.5	37.5
2	Nasion-subnasion (nose length)	29.5 (28.3–31.1)	30.5	24.2
3	Subnasion-stomion (philtrum and upper lip length)	9.8 (8.9–11.5)	10.9	17.2
4	Stomion-gnathion (chin and lower lip length)	22.5 (20.4–25.0)	21.0	21.0

* Assuming the trichion-gnathion length (total face length) = 100.
** range of variation (minimum and maximum).

The idea that the proportions of the face of the Duchess were modified, to make them fit better with a canon of classical beauty, seems in accordance with what is known about the way of painting of Titian. According to a contemporary, Giacoino Palma the younger, the painter first outlined the figure on the canvas with a few vigorous strokes of the brush:

"Then . . . turned the paintings to the wall and left them there for some months without ever looking at them. When, once again he wished to return to them, . . . on discovering something that was not in agreement with the subtlety that he intended, just like a kindly physician medicating a patient, when it was needed to strip off some excrescence or abundance of flesh, . . . he would operate and reshape the figures, reducing them to the most exquisite symmetry to best represent the beauty of nature and art."

Conclusions

The present study further corroborates the idea that the remains kept in the Church of Santa Chiara in Urbino indeed belong to the Duchess Eleonora Gonzaga della Rovere. Even more important, it shows that the use of forensic methods can significantly contribute to the history-of-art debate in an important field such as that of the Renaissance portrait.

Acknowledgments

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Erratum

Erratum/Correction of Rollo et al. Titian's secret: comparison of Eleonora Gonzaga della Rovere's skull with the Uffizi portrait. J Forensic Sci 2005 May;50(3):602–607.

It has come to the attention of the Journal that on page 606, right column, line 9. Giacoino Palma should be Giacomo Palma.

The Journal regrets this error. Note: Any and all future citations of the above-referenced paper should read: Rollo et al. Titian's Secret: Comparison of Eleonora Gonzaga della Rovere's Skull with the Uffizi Portrait. [Published erratum appears in J Forensic Sci 2005 Sept;50(5)] J Forensic Sci 2005 May;50(3):602–607.