



## The face of the poet Dante Alighieri reconstructed by virtual modelling and forensic anthropology techniques

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### ABSTRACT

This paper describes the multi-disciplinary approach to reconstruct the face of Dante Alighieri (1265–1321). Since Dante's sepulchre will be opened in 2021, the reconstructive process is based on morphological and metric data collected on the poet's cranium during the formal identification of his remains in 1921 by the anthropologist Fabio Frassetto, as well as on the resulting plaster model. Starting from this plaster model and a morphologically compatible reference mandible, since the original mandible was never found, a 3D digital model of the complete skull was obtained by reverse engineering and virtual modelling techniques. The most important aspect in this work was the method of virtual modelling proposed for the ex novo generation of the mandible. The physical model of the skull (cranium + mandible) was then produced by means of a rapid prototyping system. This model was finally used to recreate Dante's face via traditional facial reconstruction techniques currently used in forensic anthropology.

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### 1. Introduction

Dante Alighieri (1265–1321) is often called “the Poet” to underline the widely recognized historical importance of the author of *The Divine Comedy*. The year 2006 marked the VII centenary of this literary classic (1306–2006). This celebration was the perfect occasion to attempt the reconstruction of Dante's face, in conformity to the features of the cranium, in order to acquire a better idea of the poet's physical appearance. In fact, there are reasonable doubts about the accuracy of his likenesses in the vast number of illustrations of him, which have been inspired directly or indirectly by the first portraits or descriptions of the poet. For example, in Giovanni Boccaccio's *Trattatello in Laude di Dante* (Life of Dante) (Boccaccio, 1355–1370), the mature poet is described as of medium height, rather bent, with a long face, aquiline nose, rather large eyes, big jaws and the lower lip more prominent than the upper one. The painting by Giotto (1337–1340), in the Santa Maria Maddalena chapel of the Bargello palace in Florence, depicts a young Dante (if indeed it is Dante) with a strong jaw, prominent chin and slightly hooked nose. A painting in the Florentine Santa Croce cathedral by Taddeo Gaddi was destroyed in 1556, but

apparently represented an elderly Dante as a severe judge and prophet. In another portrait, discovered 20 years ago in the palace of the Arte dei Giudici e dei Notai in Florence, Dante is represented with facial features somewhat different from the traditional view, particularly the nose, which remains long, but does not have the classic aquiline profile (although some scholars consider this portrait an unfaithful representation).

These ancient portraits gave rise to the universally known image of the poet, which has inspired all subsequent paintings of Dante and which has now become part of the collective imagination. However, it is important to remember that the representations of the facial features of the poet were mostly influenced by historical-cultural aspects rather than anatomical considerations on Dante's skull. Moreover, the many death masks of Dante do not help recreate his true appearance since they are not considered authentic, i.e. taken directly from the cast of the dead poet's face, but rather artefacts (Ricci, 1891: 281; Ricci, 1924): 168.

Therefore, the facial reconstruction approach used in forensic science could be a useful way to recreate the facial appearance of Dante Alighieri. This method, primarily developed to reconstruct the faces of unidentified persons from skeletal remains, has also been applied in the archaeological field to recreate the look of historic figures (Wilkinson and Neave, 2003) and mummies (Cesarani et al., 2004; Gill-Robinson et al., 2006).

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In forensic science, it has been employed for over a century, using either the Russian method (anatomical approach to facial reconstruction) developed by the anthropologist Gerasimov (1971) or the American one (Snow et al., 1970; Krogman and İşcan, 1986) based on tissue thickness points. It is well recognized that a combination of the Russian and the American techniques provides the best result (Prag and Neave, 1997). However, facial reconstruction in the field of archaeology can be more difficult than in forensic science, due to the fragmented condition that often characterizes archaeological remains, and the resulting possibility of missing elements. The same problem occurred with Dante's skull, whose mandible was never found.

The aim of this multi-disciplinary project, involving both engineers and anthropologists, was the reconstruction of Dante Alighieri's face. Firstly, the paper describes the process of the reconstruction of Dante's skull using reverse engineering, virtual modelling, rapid prototyping techniques (Lee, 1999). The most important aspect in this work was the method of virtual modelling proposed for the ex novo generation of the mandible. This bone was obviously needed to complete the skull used as the basis for the reconstructive approach employed in forensic anthropology. The paper also describes the facial reconstruction technique (Taylor, 2001; De Greef and Willems, 2005) in order to provide a representation of Dante's face, which morphologically conforms to anatomical traits of the skull.

## 2. Previous investigations

Following his death in Ravenna in 1321, probably due to a malaria attack, Dante was buried in the church of San Francesco (Ricci, 1891; Mesini, 1965). Despite the repeated requests of restitution by his native Florence, Dante's remains were probably left inside the original marble sarcophagus until 1515–1519 (Mesini, 1965). However, the election of the Florentine Giovanni de' Medici as Pope Leo X favoured the remains transfer, greatly increasing the risk Ravenna would lose Dante's remains. It is certain that his bones were removed from the tomb by 1519, since the Florentine envoys sent to Ravenna in that year to bring the remains back to Florence found the tomb empty (Ricci, 1891). To prevent the restitution of the poet's remains, the monks of the convent evidently removed them through a hole made in the sarcophagus (Mesini, 1965). The bones then remained hidden – nobody knowing exactly where – until 1865, when, during restoration works near the empty tomb carried out for the VI centenary of the poet's birth, they were accidentally discovered inside a wooden chest (Fig. 1) behind a wall in the Braccioforte chapel adjoining the tomb. The box contained the following inscription, added in 1677 by father Antonio Santi, guardian of monastery of San Francesco, attesting these were Dante's bones:

Dantis Ossa – a me Fra Antonio Santi – hic posita – Ano 1677 die 18 octobris”.

After being examined and displayed (Puglioli and Bertozzi, 1870), the poet's bones were returned to the marble sarcophagus from which they had been removed almost three and a half centuries before.

In 1921, on the occasion of the VI centenary of Dante's death, a scientific study of his skeletal remains was conducted by the anthropologists Fabio Frassetto, of the University of Bologna, and Giuseppe Sergi, of the University of Rome. The results of this study and subsequent research appeared in several scientific papers (Frassetto et al., 1923) and, in particular, in a valuable book published by Frassetto in 1933 (Frassetto, 1933). This volume contained the description of the bones as well as 297 measurements and scale photographs of the cranium and postcranial skeleton. Finally, on the basis of the morphological and metric data, a set of photos and



Fig. 1. Wooden chest containing the skeletal remains of Dante Alighieri.

a partial cast of face and palate, Frassetto created a plaster model of Dante's cranium.

## 3. Case study

It is well known that, in a traditional approach, the preliminary step for the facial reconstruction process is to make a cast of the skull under examination.

In this case, since the Dante's sepulchre will be opened in 2021, for the anniversary of the seventh centenary of his death, the process was carried out starting from Frassetto's plaster cranium model. Moreover, since it would be impossible to reconstruct the face without a mandible, it was necessary to recreate a mandible consistent with the morphological and morphometric characteristics of Dante's cranium.

Therefore, the whole reconstructive process of this project was subdivided in two main steps: the reconstruction of the skull and the reconstruction of the face. In the first step, innovative technologies such as reverse engineering, virtual modelling and rapid prototyping were employed to obtain a physical model of the complete skull of Dante (cranium + mandible). Then, this skull model was used to reconstruct Dante's face according to the traditional techniques of forensic anthropology.

### 3.1. Reconstruction of the skull

A preliminary examination showed that the plaster model of Dante's cranium was created with remarkable precision, since the differences between the measurements carried out on the original cranium and those made on the model were never greater than 0.7 mm. Due to the historical value of this model created by Frassetto in the first decades of the last century, a replica of this artefact

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