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Did Leonardo da Vinci have Strabismus? Assessment of binocular alignment in a historical figure

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Abstract

Purpose : Leonardo da Vinci was renowned for his expansive view of the scope of the natural and humanistic universe, but few portraits of him are generally recognized. One case is the sculpture of 'David' by his master, Verrocchio, which is often considered to be based on the young Leonardo as a model when he arrived as an apprentice in Verrocchio's studio. The eyes in this sculpture are evidently divergent. The question to be assessed is whether this ocular divergence is an artistic trope or a

veridical depiction of Leonardo's ocular physiology.

Methods : A set of age-appropriate likely portraits or self-portraits of Leonardo with clear depictions of both eyes in the face were identified for analysis. To meet this identification, a depiction had to a) have a date matching Leonardo's age at the time, b) be attributable to Leonardo or his master, Verrocchio, and c) have a physiognomy consistent with the 'David' sculpture. The ocular vergence angle was assessed by fitting circles and ellipses to the pupils, irises and eyelid apertures, and by measuring the Hirschberg angle of the irises to the light reflex in the two eyes

Results : The divergence angle in most of the identified portraits averaged about 10 deg, suggesting that Leonardo had a habitual exotropia of the ocular alignment. The eye alignment in two likely self-portraits was orthotropic, consistent with the eyes straightening up when viewing his self-image in a mirror, implying that the exotropia was of the intermittent type. However, in the orthotropic self-portraits the two eyes show marked discrepancies, suggestive of attempts to depict a interocular suppression condition.

Conclusions : Other famous artists, such as Rembrandt, have been found to show an exotropic eye configuration in self-portraits. In the case of Leonardo da Vinci, a helping to explain his facility in depicting space through the resultant monocular vision to focus on monocular cues to depth such as linear and aerial perspective. It may also explain his failure to identify binocular disparity as a depth cue despite a careful analysis in his notebooks of the geometric difference between the views of the two eyes.

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Verrocchio's 'David', often attributed as da Vinci at age 14.

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