Lincoln's Craniofacial Microsomia

Three-dimensional Laser Scanning of 2 Lincoln Life Masks

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Examination of 2 life masks of Abraham Lincoln's face was performed by means of 3-dimensional laser surface scanning. This technique enabled documentation and analysis of Lincoln's facial contours and demonstrated his marked facial asymmetry, particularly evident in the smaller left superior orbital rim. This may have led to retroplacement of the trochlea on the left side, leading, in turn, to the mild superior oblique paresis that was manifested intermittently during adulthood.

METHODS

A bronze copy of the 1860 mask (Figure 1A) and a plaster copy of the 1865 mask (Figure 1B) were made available for study at the Chicago History Museum (formerly known as the Chicago Historical Society). We investigated Lincoln's facial contours by photographing the masks from various angles including those particularly useful in comparing the orbits on the 2 sides (Figure 2). We then applied, for the first time, 3-dimensional laser surface scanning for analysis of the 2 masks, according to established technique.

The laser scanner used (VIVID 700; Konica Minolta Sensing Americas Inc, Ramsey, New Jersey) operates on the principle of a light-stripe triangulation range finder. The subject's facial surface is scanned from top to bottom with a class 2 laser light stripe projected from a distance of at least 1 m. The position of an illuminated surface point relative to the viewpoint is obtained by triangulation. The subject's facial surface is scanned from top to bottom with a class 2 laser light stripe projected from a distance of at least 1 m. The position of an illuminated surface point relative to the viewpoint is obtained by triangulation. The resolution in the x and y coordinates is 200 range points per scan. The reliability of this method has been tested and found to be good.

Scanning of the masks from at least 3 different views, that is, from the front and to each side, was necessary to enable the computer program (Polygon Editing Tool software; Konica Minolta) to reconstruct a 3-dimensional image, or moulage, of each of the masks. One facial scanning may contain 40,000 points, and a polygonal mesh is formed of all these points, representing the facial surface. Cartesian coordinates (x, y, and z) from facial landmarks can be identified and the surface distance between them calculated using computer software (Geomagic Studio, version 9; Geomagic Inc, Research Triangle Park, North Carolina). These landmarks are standardized points used in physical anthropology, and their use in 2- and 3-di-

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mensional analysis of facial shape is well accepted. With the software, 3-di-
mensional images can be analyzed in full 3 dimensions, superimposed, and
rotated for better visualization. This tech-
ique, with its accuracy, ease of use, and
convenience, has proved particularly use-
ful clinically in documenting and analyz-
ing craniofacial anomalies of various types,
particularly cleft lip, in children. In ana-
lyzing the Lincoln masks, it provided
views from any desired angle and en-
abled measurements to be made so as to
quantify the degree and nature of the fa-
cial asymmetry.

**RESULTS**

The following statements apply to both the 1860 and 1865 masks. Bi-
lateral facial asymmetry is evident in the following ways:

Gross inspection of the overall face shows that the left half is smaller than the right half (Figure 2 and **Figure 3**). When a mirror image of the right half of the 3-dimensional digital moulage is superimposed on the original 3-dimensional image, additional details appear. Using the software for superimposition and analysis, a color diagram is gener-
ated demonstrating where compo-
nent mini-areas of the 2 images do
not match (**Figure 4**). The col-
ored area is coded so that green indi-
cates where the superimposed im-
ages match fairly well; blue, yellow,
orange, and red areas reveal where these images are mismatched. Sub-
stantial asymmetry is apparent at the superior orbital rim, especially the medial half, where a dark blue area shows a large degree of mismatch.

The anterior left orbital aperture is larger than that on the right, pri-
marily because of rounding of the left superior rim compared with the rela-
tively flattened rim on the right, which also appears to be thicker than its counterpart on the left. This pro-
duces, in turn, upward displace-
ment of the left superior palpebral sul-
cus (evident only on the 1865 mask).
Incidentally noted is absence of the flattening of the left side of the forehead, a sign seen in unicoronal synostotic plagiocephaly.

Soft tissue asymmetries evident in the nose, lips, and ears have been discounted as either extraneous or the result of technical factors.

Direct examination of the masks for the dent in the forehead above the left eye as described by Kempf could not confirm this defect in either of the masks available for study. However, a furrow in the left side of the glabella is visible on the 1865 mask. This shadow is most likely related to the way the plaster mold was removed from Lincoln's face in 1865. Forceful corrugation of the brows so that the mold would break into pieces to facilitate removal from the face most likely produced a break in that area and, thus, a subtle defect in the plaster reconstitution. We interpret this shadow as an artifact rather than a real deformity.

COMMENT

Other than the general opinion of the time that Lincoln was less than handsome, little attention has been paid over the years to his facial asymmetry. Photographers were aware of it, and their overwhelming preference was to photograph him from the right of the midline. Artists and sculptors were also aware of it; Gutzon Borglum, the sculptor responsible for the Mount Rushmore likenesses, remarked that the left side of Lincoln's face was "primitive," "immature," "unfinished."9

Facial asymmetry to some degree is so common that it can be considered normal. That it is obvious in some certified beauties shows that, in itself, it does not preclude the pursuit of happiness.10 However, in Lincoln's case, it is unusually marked and may even be considered part of the spectrum of hemifacial microsomia or, to use a stricter terminology, craniofacial microsomia, because it involves the upper half of the face as well as the lower half. Lincoln did not have the anterior displacement of the external ear on the involved side that is seen in the more severe cases of hemifacial microsomia, which is the second most common facial birth defect after cleft lip and palate.

That Lincoln experienced intermittent left-sided hypertropia was observed during his lifetime by reporters covering the Lincoln-Douglas debates in 1858 and by William H. Herndon, his partner in law practice, among others.11 It was described particularly well by Thomas Shastid, an ophthalmologist who was told about it by his father, who remembered Lincoln from the days they shared in New Salem, Illinois, in the 1830s when Lincoln was a shopkeeper and postmaster. The elder Shastid had also seen Lincoln during the 1858 debates and in several trials as a lawyer, and noted the tendency for Lincoln's left eye to roll upward when he was excited.12

A rare straight frontal view in a photograph taken in November 1863 shows a manifest hyperdeviation of Lincoln's left eye (Figure 5). This strabismus has been discussed several times over the years.13-15 Goldstein16 takes special note of other photographs of Lincoln that show a right-sided head tilt and makes a convincing case that Lincoln had a slight paresis of the left superior oblique muscle.

The cause of this paresis is less certain. It is tempting to relate it to the trauma Lincoln suffered at the age of 10 years when he was kicked in the head by a horse and was unconscious for several hours. Previous writers have raised the possibility of indirect trauma to the fourth cranial nerve or to direct injury to the trochlea itself.17 Complicating this scenario is the familial occurrence of hypertropia, as documented in photographs of Lincoln's cousin John Hanks and especially of Lincoln's son Robert Todd Lincoln, the only Lincoln child to survive to adulthood. In Robert's case, a photograph also shows a head tilt to the opposite side of the left hypertropia, making it likely that he also had a superior oblique paresis. From the few photographs of him that have been published, marked facial asymmetry is not apparent.

Could Lincoln's hypertropia be related to craniofacial microsomia? If his left superior orbital rim was, indeed, smaller than the right, and especially if the trochlea on the left was displaced backward relative to the right, could this in itself have led to underaction of the left superior oblique?

What has been called "desagittalization of the superior oblique" has been proposed to account for the muscle underaction commonly seen in frontal plagiocephaly caused by premature closure of one coronal suture.17-19 This produces underdevel-
development of the frontal bone on one side, with flattening of the forehead and backward displacement of the superior orbital rim on the involved side. When the superior orbital rim is displaced backward compared with the other side, the trochlea is also relatively retroplaced. This has 2 effects: it decreases the effective length and tone of the superior oblique muscle and it changes the angle at which the reflected tendon inserts on the sclera. Both mechanisms weaken the capacity of the superior oblique muscle to depress and intort the eye. The stronger antagonist inferior oblique muscle then elevates the eye. Because Lincoln manifested hypertropia only occasionally, the paresis of the superior oblique muscle was mild, and only a small deviation of the trochlea would have been enough to produce this effect. If there had been a rim fracture, a marked disturbance of the trochlea would have been more likely and the hypertropia would more likely have been constant.

Various anatomical abnormalities of the superior oblique muscle, ranging from absence to severe floppiness or laxity of the tendon, have been described in a large percentage (up to 87%) of children undergoing surgery for correction of congenital superior oblique palsy, including some with craniofacial dysostosis. Whether this was present to some mild degree in Lincoln’s case is impossible to say.

Facial asymmetry in congenital superior oblique palsy, severe enough to be deemed a deformational plagiocephaly, with the smaller half on the side contralateral to the congenital superior oblique palsy, has been reported in several series. This asymmetry is probably caused by the associated severe torticollis in these children as their facial structure develops in the first decade of life. Lincoln’s problem was too minor for this mechanism to operate. Parenthetically, among the hallmark deformities in unicoronal synostotic plagiocephaly is an elevated superior orbital rim with subsequent rounding of the palpebral fissure, an anomaly that Lincoln’s face also shows on the left side.

SUMMARY

What influence did this minor anomaly of his face and eyes have on Lincoln’s life and the course of history? Probably none at all—except possibly that described by Stephen Vincent Benét in John Brown’s Body, the poetic narrative that won a Pulitzer Prize in 1929. In an imagined soliloquy, Lincoln thinks:

I can’t be smart like they are smart.

I’ve known that since I was an ugly child.

It teaches you to be an ugly child.

Figure 5. A, The famous Alexander Gardner photograph of Lincoln taken shortly before the Gettysburg Address in November 1863. B, Close-up view shows left-sided hypertropia.
Submitted for Publication: August 31, 2006; accepted December 8, 2006.

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Financial Disclosure: None reported.

Previous Presentations: Presented in part at the 19th Annual Meeting of the Cogan Ophthalmic History Society; April 1, 2006; Hershey, Pennsylvania.

Acknowledgment: Robert A. Kent, Collections Manager, Chicago History Museum, provided access and assistance in examination of the Lincoln masks.

REFERENCES


Correction

Error in Text. In the Ophthalmological Numismatics feature about Mauno Vannas, published in the May issue of the Archives (2007;125[5]:627), the description contained an error. The second sentence should have read, “Vannas was a great ophthalmologist and surgeon.”