

# Medical Archaeology

## Neurological Aspects of the David–Goliath Battle: Restriction in the Giant’s Visual Field

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The celebrated battle between David and Goliath that took place more than 3,000 years ago in the Valley of Elah is fully described in the Bible’s Book of Samuel I [1,2]. Throughout the centuries, this story became a symbol of the victory of faith over brutal force, the mastery of good over evil. It inspired the imagination of writers [3], composers, sculptors (Donatello, Michaelangelo, among others.), and artists (Rembrandt, Doré, etc.) [Figure 1]. The name David, personifying heroism and goodness, has been given by parents to their sons from generation to generation in different countries and in various languages.

Beyond the mystique of this time-honored story, the details and outcome of this battle can be explained by contemporary scientific and medical knowledge, and several articles and letters have been published in this regard [4–8]. Among the theories is the assumption, although never proven, that Goliath might have had a visual disorder. I shall try to show that Goliath did in fact suffer from visual field restriction.

### The story

David was a young, handsome ("of fair countenance") and nimble shepherd. We know of his strength and bravery and that he had overcome wild beasts, including a lion, while minding the sheep. No soldier, David the youth was sent to bring food from his father’s

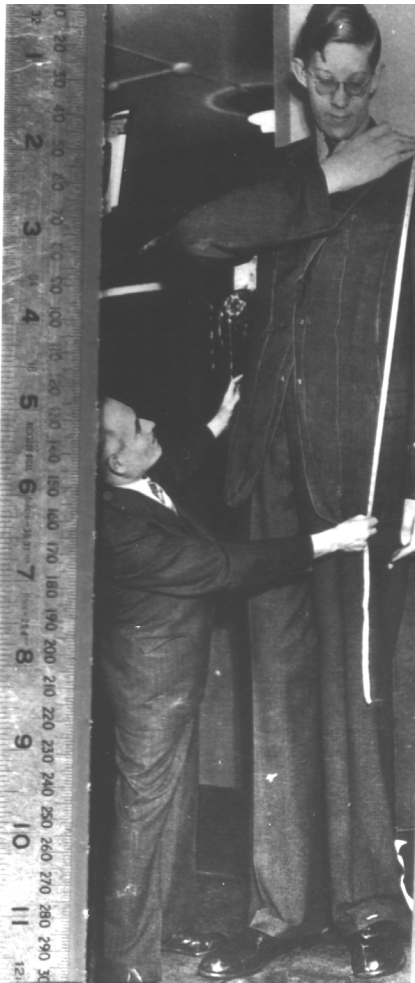
house to his older brothers at the Israelite camp. The Philistine giant, meanwhile, was daring the Israelites to send out their best fighter. After 40 days and no response, it was David who took up the challenge. A devout believer in the power of God and an enthusiastic patriot, David was also a cunning and pragmatic fellow. He knew of King Saul’s promise that he who conquered Goliath could take the king’s daughter as a wife and would be granted wealth for himself and his family. He refused the king’s proposal to don armor of heavy metal, preferring to remain in his shepherd’s garment and armed with a mere stick, sling and smooth stones – weapons with which he was familiar. Thus were David and Goliath the representatives of the warring Israelite and Philistine armies, and the victory of one foretold the defeat of the other.

During the battle David ran fast, as noted several times in the Bible ("David hastened and ran towards the army to meet the Philistine"). In contrast, Goliath, a terrifying giant from the area of Gat, was slow-moving and ponderous [1–3]. It is most likely that Goliath was suffering from acromegaly. His height was "six cubits



**Figure 1.** "David defeats Goliath." Painting by P. Puget, 18th Century. Note typical facial features of acromegaly in Goliath’s head, a point remarkable since the painting was done more than one hundred years before Marie originally described the condition in 1886.

and a span" or according to another version "four cubits and a span" (approximately 2.5–3 meters). Such gigantism is a feature of pituitary macroadenoma with hypersecretion of growth hormone from childhood [4,9,10]. Measurements of acromegalic



**Figure 2.** Robert Wadlow, acromegalic giant, height 272 cm (measured by Drs. C.M. Charles and C. MacBride on June 27, 1940 in St. Louis, MO, USA).

individuals approximating such a height have been recorded [Figure 2].

It is noted several times in Samuel I that he "came to pass and drew nigh to meet David." The slowness of Goliath has been attributed to three phenomena. The first is the heavy weight. In addition to his vast physical size, Goliath was dressed in a heavy metal suit of armor. "And he had a helmet of brass upon his head, and he was armed with a coat of mail; and the weight of the coat was five thousand shekels of brass [about 70 kg]. And he had greaves of brass upon his legs, and a target of brass between his shoulders. And the staff of his spear was like a weaver's beam; and his spear's head weighed six hundred shekels of iron." The second explanation is that arthrop-

athy and myopathy frequently appear in the late stages of acromegaly [9]. There have been assumptions that the giant may have been affected by these complications, but I found no indication of this in the original text. The third theory claims a visual disorder. Goliath was not blind; he saw and taunted the young boy who confronted him. David carried a stick, yet Goliath saw "several sticks," which may be one of the indications of his impaired vision. I suggest that Goliath suffered from visual field restriction. Bitemporal hemianopsia is seen in large pituitary macroadenomas as a result of optic chiasm compression in the suprasellar region [Figure 3].

### Hypothesis

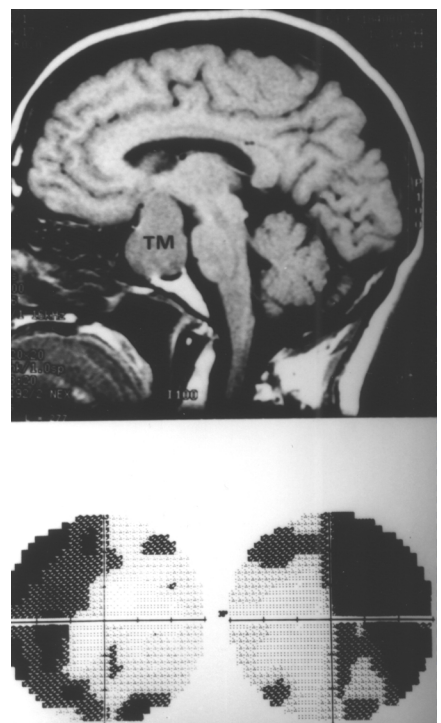
Intrigued by the story, for more than 20 years I have repeatedly examined the original text of the Bible, seeking for an allusion to the visual field difficulties of Goliath. I believed that the original text, so detailed in the description of Goliath and his behavior, must contain at least a hint to his supposed visual field restriction.

Only recently did I succeed in finding evidence, which lies in the words twice mentioned in the Bible: ".... And a man bearing a shield went before Goliath." This man was most likely a guide who would indicate to Goliath the direction from which the enemy was approaching. Running swiftly, David could intermittently disappear from Goliath's vision. Surprised and disconcerted, the giant was unprepared to defend himself against the stone that David slung. While astonishingly powerful in a face-to-face duel, Goliath was ineffectual in mobile combat due to his slowness and visual field limitations.

The battle began with psychological attacks from both sides. The large Philistine abused and insulted the Israelites, confident that he would defeat any of their warriors. Both David and Goliath swore to kill each other and to give the enemy as "flesh unto the fowls of the air, and to the wild beasts of the field." David, highly motivated, addressed Goliath: "I come

to thee in the name of the God of Israel." The combat itself was not a face-to-face struggle. While the giant "Philistine arose and came slowly to meet David, the quick David ran toward the army to meet the Philistine." Owing to his agility, a function not only of his youth and size but of his experience scaling the Judean hills while minding his flock, he succeeded in transforming the battle into a mobile duel. He struck Goliath from a distance, "David put his hand in his bag and took thence a stone, and slung it, and smote the Philistine on his forehead."

The confrontation between David and Goliath, as described in the Book of Samuel I, has been analyzed using modern ballistics and computational methods. The result confirms the detailed descriptions of the battle and its physical outcome – a stone sunk into Goliath's forehead [11]. Such a rapid and sharp injury of the head could possibly kill even a healthy person



**Figure 3.** Magnetic resonance imaging of pituitary macroadenoma [TM]. The tumor enlarged the sella turcica, eroded its floor and pressed upon the optic chiasm causing bitemporal hemianopsia. TM fills the third ventricle almost to the intraventricular foramen of Monro.

from a distance of up to 40–80 meters [8,11]. How much more so in the case of acromegaly, where the frontal sinuses became enlarged and the frontal bone consequently thinner [6]. Transorbital intracranial penetration has also been suggested [12].

I have not found evidence to support the theory that Goliath suffered from multiple endocrine neoplasia type 1, including hyperthyroidism, which caused extensive osteitis fibrosa and a brown tumor on his forehead through which the stone pierced his brain. Neither have I found evidence that he may have been hypoglycemic on the morning of the contest [5].

The smooth stone was slung at high speed, force and accuracy at the unprotected face of Goliath, where it "sunk into the forehead." It caused a penetrating craniocerebral injury, insufficient to cause immediate death; but following this blow, Goliath "fell upon his face to the earth." The reason for this fall could have been a sudden loss of consciousness due to brain contusion induced by the penetrating smooth stone. As a result of the trauma, acute occlusion of foramen Monro with bleeding and edema [13] of injured suprasellar pituitary macroadenoma is a possibility. This could have led to acute decerebration. The possibility of epidural hematoma seems

less likely in view of the fact that his temporal bones were protected by the "helmet of brass upon his head." Pituitary apoplexy induced by craniocerebral trauma is rarely observed in head injuries of patients suffering from pituitary tumors [6].

Goliath did not expire immediately after the stone had "sunk into the forehead." David quickly "ran and stood upon the Philistine, and took his sword, and drew it out of the sheath thereof, and slew him and cut off his head therewith." The death of Goliath was not an immediate result of the head injury that caused him to "fall on the earth" (unconsciously, most probably), but due to his decapitation.

After the battle David brought Goliath's head to Jerusalem and presented it to King Saul. As promised, he did indeed marry the king's daughter. He became a cherished member of King Saul's court, his proficiency on the harp and the poetry of his psalms being the only balm to soothe the king's tormented soul. The rest is history.

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*Contraceptives should be used on every conceivable occasion.*

*Spike Milligan, Irish writer (1918–)*

## Capsule



### Younger and longer is better

Amid the excitement surrounding recent cloning of animals from adult somatic cells was the lingering doubt that the cloned offspring would not be able to live out their normal life span. Because cells can divide only a finite number of times in their lives, the progeny of the adult nucleus used for cloning might be limited in their ability to divide. Lanza et al. show that they are not. Even when senescent cells are used as nuclear donors, the cells of cloned calves can divide more times than cells of normal animals of the same age. Another putative index of cell

aging, telomere length, is increased, rather than decreased, and above normal in cells from the cloned animals. Exactly how the cloning process reprograms the donor nucleus to a more youthful state is not clear, nor are the implications of these findings for the cloned organisms' life spans. Nevertheless, cloning from adult cells now seems a more realistic possibility.

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