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The Zygomaticotemporal Nerve and Its Relevance to Neurosurgery

R. Shane Tubbs[1], Martin M. Mortazavi[1], Mohammadali M. Shoja[2], Marios Loukas[3], Aaron A. Cohen-Gadol[4]

Key words
- Anatomy
- Craniotomy
- Entrapment
- Neurosurgery
- Peripheral nerve

Abbreviations and Acronyms
ZTN: Zygomaticotemporal nerve

From the [1]Section of Pediatric Neurosurgery, Children's Hospital, Birmingham, Alabama, USA; [2]Neuroscience Research Center, Tabriz University of Medical Sciences, Tabriz, Iran; [3]Department of Anatomical Sciences, St. George's University, Grenada, West Indies; [4]Goodman Campbell Brain and Spine, Indiana University Department of Neurological Surgery, Indianapolis, Indiana, USA

To whom correspondence should be addressed: Aaron A. Cohen-Gadol, M.D., M.Sc. [E-mail: acohenmd@gmail.com]

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■ BACKGROUND: **Although neurosurgical procedures are frequently performed in its territory, the zygomaticotemporal nerve (ZTN) is rarely mentioned in this literature, even though this nerve has been implicated in postsurgical pain syndromes and may become entrapped, resulting in chronic headache. The present study was performed to further elucidate the anatomy of the ZTN.**

■ METHODS: **Twelve cadavers (24 sides) underwent dissection of the lateral temporal region to analyze the course, relationships, and landmarks for the ZTN.**

■ RESULTS: **A ZTN was found on all but 1 left side. This nerve left the lateral zygoma to enter the temporal fossa and ascended up through the temporalis muscle or between this muscle and its outer fascia to become subcutaneous near the pterion. Fascial or muscle penetration occurred at a mean of 2.3 cm superior to the zygomatic arch. The majority of nerves then coursed posteriorly, approximately parallel to the frontoparietal suture of the pterion. The mean distance from the ZTN to the frontozygomatic suture was 12 mm.**

■ CONCLUSIONS: **Based on our study, the ZTN has a fairly standard course that takes it along a superficial pathway overlying the pterion. It is our hope that with a greater appreciation for its anatomy and landmarks for its localization as provided herein, that injury to the ZTN may be avoided with surgical procedures in its territory, and if entrapped, may be more easily identified by the surgeon.**

INTRODUCTION

The zygomatic nerve, a branch of the maxillary division of the trigeminal nerve, arises in the pterygopalatine fossa. This nerve carries cutaneous fibers and postsynaptic parasympathetic fibers arising from the pterygopalatine ganglion. These latter fibers, originating from the superior salivatory nucleus and passing through the greater petrosal branch of the facial nerve, terminate on the lacrimal gland. The zygomatic nerve enters the orbit via the inferior orbital fissure and along the floor of the orbit (infraorbital sulcus) branches into the zygomaticofacial nerve and the zygomaticotemporal nerve (ZTN) with an angle of approximately 20° to 40° between them (**Figure 1**) (4, 7). In the lateral orbit, a communicating branch from the lacrimal nerve joins the ZTN. The ZTN then passes through the zygomaticotemporal foramen

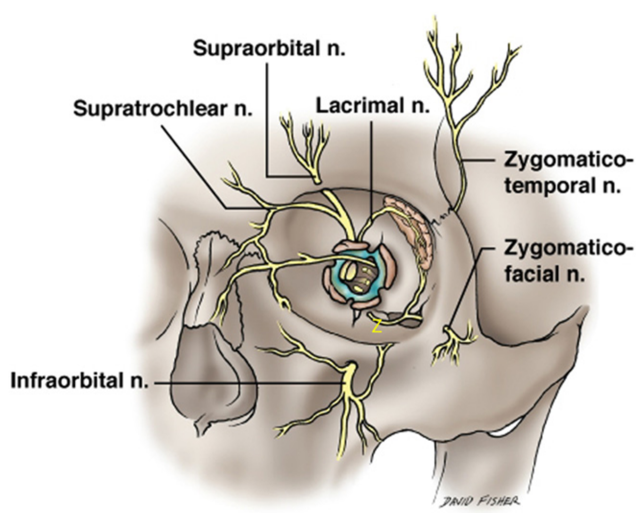

Figure 1. Schematic drawing of the zygomaticotemporal nerve from an anterior view noting its relationships to the lateral orbital wall. Note the main trunk of this nerve, the zygomatic nerve (*Z*).

located on the temporal surface of the zygomatic bone to enter the temporal fossa (10).

Although neurosurgical procedures are frequently performed in its territory, the ZTN is rarely mentioned in the neurosurgical literature, and only a handful of studies are found in the general medical literature regarding its anatomy. Because this nerve may become entrapped, resulting in protracted pain in the temporal region, or injured with neurosurgical procedures (3, 12), the present study was performed to further elucidate its anatomy.

MATERIALS AND METHODS

Twelve cadaveric heads (24 sides) underwent dissection of the lateral temporal region to analyze the course, relationships, and landmarks for the ZTN. Ten fresh and 2 embalmed adult cadavers underwent dissection of the lateral temporal region. Eight specimens were male, and 4 were female; the age range at death was from 55 to 101 years (mean 74.5 years). In the supine position and in the lateral position, the skin and superficial fascia were carefully reflected. Terminal branches of the ZTN were identified and traced deeply through the temporalis fascia and muscle to the zygomaticotemporal foramen. Measurements were made of the diameter of the ZTN and its distance posterior to the frontozygomatic suture. Documentation of the relationship between the ZTN and surrounding anatomical structures, including the temporalis muscle and auriculotemporal and lacrimal nerves, was made. All measurements were made with digital calipers (Mitutoyo, Kanagawa, Japan). Statistical analysis was performed between cadavers and genders using Statistica for Windows (Tulsa, Oklahoma, USA) with significance set at $P < 0.05$.

RESULTS

A ZTN was found on all but 1 left side (4.2%) on a female cadaver. This nerve left the temporal surface of the zygomatic bone via the zygomaticotemporal foramen and ascended more or less vertically up through the temporalis muscle or between this muscle and its outer fascia to become subcutaneous over the pterion (**Figure 2A**). The majority of nerves, which were always a single trunk, then coursed posteriorly, approximately parallel to the frontoparietal suture of the pterion. In its ascent between the bone

Figure 2. (**A**) Cadaveric dissection demonstrating the left zygomaticotemporal nerve (ZTN) (over the blue card) at its emergence from the temporal fascia. The frontozygomatic suture (FZS) is seen at the black dot. The distance measured between the main trunk of the ZTN in this region and the FZS is shown as the *yellow line*. (**B**) Cadaver seen in **A** after opening of the temporal fascia. The left ZTN and its branches are seen overlying the blue cards. The FZS is marked with black ink. The distances measured between the main trunk of the ZTN and the suture and zygomatic arch are shown. (**C**) Left-sided cadaveric dissection after removal of the temporalis muscle demonstrating the exit of the ZTN leaving its foramen and ascending up and posterior to the FZS. For reference, note the left zygoma (marked *Z*).

and the temporalis muscle, the ZTN pierced the superficial temporal fascia on average 2.3 cm (range 1.9 to 2.6 cm) superior to the zygomatic arch. Cutaneously, the ZTN was primarily distributed to the skin of the anterior temporal region (**Figure 2B**). The superior temporal line was the most superior extent of any ZTN distal fibers. The ZTN was found to have 1 to 3 terminal branches (mean 1.8) (**Figure 2B**). The mean diameter of the ZTN was 0.9 mm, with a range of 0.8 to 1.1 mm. The mean distance from the ZTN to the frontozygomatic suture was 12 mm (range 8 to 15 mm) (**Figure 2C**). The ZTN was found to communicate with the posteriorly located auriculotemporal branch of the mandibular nerve on 3 sides (13%) and anteriorly with the lacrimal nerve (branch of the ophthalmic nerve) on 2 sides (8.7%). Connections with the auriculotemporal and lacrimal nerves were approximately horizontal. We did not find any communications between the ZTN and the temporal branch of the facial nerve in any specimen (13). No signs of past surgery or pathology were identified in the area of dissection in any specimen. No statistical difference was noted between genders or sides.

DISCUSSION

Neurosurgical procedures, such as craniotomies, often result in persistent headache that may be due to neurovascular compromise, nerve traction during surgical procedures, or compression of the nerve by scar tissue (3, 12). Damage to sensory nerves of the head may also lead to temporary or permanent loss of sensation (1). Muscular, vascular, and fascial entrapments of peripheral branches of the trigeminal nerve, including the ZTN, have been reported as trigger points for migraine headaches (5, 13). Interestingly, surgical decompression of such nerves has led to complete resolution of symptoms in some patients (11). Specifically, the ZTN has been shown clinically to have sites of entrapment within the temporalis (13) and surgical decompression or chemical denervation of the surrounding temporalis muscle may improve migraine headache symptoms (5, 13). Some have found good results with avulsion of the ZTN in some patients with migraine headaches, and reported that second to the supraorbital and supratrochlear nerves, this nerve is the most common trigger site for such headaches (6).

Anatomically, Janis et al. (8) found in 25 specimens that the ZTN had no intramuscular course. In 11 specimens, the nerve had a brief intramuscular course, and in 14 specimens, it had a long, tortuous, muscular pathway. Totonchi et al. (13) found that the main trunk of the ZTN emerged from the deep temporal fascia on average 17 mm lateral and 6 mm cranial to the lateral canthus. Jeong et al. (9) found that the ZTN was on average 22 mm superior to the upper margin of the zygomatic arch and classified this nerve into 3 types. The type I nerve seen in 73% consisted of 2 branches. Types II (20%) and III (7%) had 3 and 0 branches, respectively. Hwang et al. (7) found that the ZTN traveled posterior to the greater wing of the sphenoid in a third of their specimens. We found a ZTN on 95.8% of sides and found that it pierced the superficial temporal fascia, on average, 2.3 cm superior to the zygomatic arch. The superior temporal line was most superior extent of any ZTN distal fibers, and the mean distance from it to the frontozygomatic suture was 12 mm. The ZTN was found to communicate with the posteriorly located auriculotemporal branch of the mandibular nerve on 13% of sides and anteriorly with the lacrimal nerve on 8.7% of sides.

Figure 3. Dry skull illustrating the details of the internal aspect of the right orbit. Note the inferior orbital fissure (*red line*) and the exit site (*yellow line*) for the zygomaticotemporal nerve from the orbit to the temporal fossa.

For variations, the ZTN has been reported to rarely travel through the sphenomaxillary fissure into the temporal fossa, although this exit site is usually directly through bone and not a suture (**Figure 3**) (2). The nerve may be absent, and if small, its territory may be compensated for by additional branches of the lacrimal nerve (2). Two branches of the ZTN may be seen (8). We found 1 (4.2%) specimen (left side) for which no ZTN was identified. Additionally, in 2 (8.7%) specimens, communication was identified between the ZTN and the more anteriorly located cutaneous branches of the lacrimal nerve. No arterial branches were noted to travel with the ZTN; however, satellite arteries are found to accompany its neighboring nerve, the zygomatic facial nerve.

Theoretically and in addition, inadvertent traction on the ZTN during pterional craniotomies may damage the postganglionic fibers that this nerve carries more deeply to the lacrimal gland, resulting in a desiccated cornea. Although we were unable to find such a relationship reported in the literature, such a complication may be underappreciated because so little is published about the surgical anatomy of the ZTN.

CONCLUSIONS

Based on our study, the ZTN has a fairly standard course that takes it along a superficial pathway overlying the pterion. It is our hope that with a greater appreciation for its anatomy and landmarks for its localization, injury to the ZTN may be avoided during surgical procedures in its territory, and if entrapped, may be more easily identified by the surgeon.

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Survival and Treatment Patterns of Glioblastoma in the Elderly: A Population-Based Study

Sasha Gulati[1,2,3], Asgeir Store Jakola[1,3], Tom Børge Johannesen[4], Ole Solheim[1,3]

Key words
- Age
- Glioblastoma
- Survival

Abbreviations and Acronyms

CI: Confidence interval
HR: Hazard ratio
ICD: International Classification of Diseases

From the [1]Department of Neurosurgery, St. Olavs Hospital, Trondheim; [2]Department of Laboratory Medicine, Children's and Women's Health, Norwegian University of Science and Technology, Trondheim; [3]MI Lab and Department of Neuroscience, Norwegian University of Science and Technology, Trondheim; and [4]The Norwegian Cancer Registry, Oslo, Norway

To whom correspondence should be addressed: Sasha Gulati, M.D. [E-mail: sashagulati@hotmail.com]

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■ BACKGROUND: **As the older segment of the population grows faster than any other age group, the number of elderly diagnosed with glioblastoma is expected to increase. The aim of this study was to explore survival and the treatment provided to elderly patients diagnosed with glioblastoma in a population-based setting. We further studied whether increased treatment aggressiveness may have contributed to a clinically important survival benefit in the elderly population.**

■ METHODS: **From the Norwegian Cancer Registry, we included 2882 patients who were diagnosed with glioblastoma between 1988 and 2008.**

■ RESULTS: **The proportion of patients ≥66 years was 42.5% (n = 1224), and 15.9% of patients (n = 459) were ≥75 years at diagnosis. Treatment patterns varied significantly between age groups ($P < 0.001$). Elderly patients (66 years) were less likely to receive multimodal treatment with resection combined with radiotherapy and/or chemotherapy. Elderly patients were more likely to receive a diagnosis of glioblastoma without histopathologic verification ($P < 0.001$). Among patients receiving multimodal treatment with surgical resection, radiotherapy, and chemotherapy, shorter survival was seen in the elderly ($P < 0.001$). Belonging to the age group ≥75 years was the strongest predictor of decreased survival ($P < 0.001$), thus seemingly of higher prognostic impact than the patterns of care. Increasing age, no tumor resection, no radiotherapy, and no chemotherapy were identified as independent predictors of reduced survival. There was a statistically significant, albeit debatable, clinically relevant survival advantage for the oldest patients (≥75 years) diagnosed in the last 5 years of the study.**

■ CONCLUSIONS: **Advancing age remains a very strong and independent negative prognostic factor in glioblastoma. Although there has been an increase in the aggressiveness of treatment provided to elderly with glioblastoma, the gain for the oldest age group seems at best very modest. The prognosis of the oldest age group remains very poor, despite multimodal treatment.**

INTRODUCTION

The incidence of glioblastoma increases with advancing age, reaching its peak after the age of 65 years (49). As the older segment of the population grows faster than any other age group, the number of elderly diagnosed with glioblastoma is expected to increase. Neurosurgeons and neurooncologists will therefore increasingly be asked to provide treatment recommendations for elderly patients with glioblastoma. Unfortunately, older patients are under-represented in clinical treatment trials. The lack of clinical trials with proportionate representation of the elderly limits generalization results to older patients as age is a known prognostic factor. Older patients may be excluded due to fear of inferior outcomes, and