

## Positional variation of the ciliary ganglion and its clinical relevance

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### ABSTRACT

Ciliary ganglion is one of the peripheral parasympathetic ganglion situated near the apex of the orbit between lateral rectus and optic nerve. During routine dissection of a human cadaver for the medical students at Kasturba Medical College, Manipal, India, we found a rare and unreported case, where, the ciliary ganglion was placed between the medial rectus and the optic nerve, lateral to the ophthalmic artery. In this report we also discuss the course, relations of the branches/roots of the ganglion, histological study and the clinical relevance of this positional variation. © *Neuroanatomy*. 2008; 7: 38–40.

**Key words** [ciliary ganglion] [optic nerve] [short ciliary nerves]

### Introduction

Ciliary ganglion provides motor innervation to certain intraocular muscles. This cranial parasympathetic ganglion is formed by aggregation of cells derived from the neural crest. It is connected to nasociliary nerve and located near the apex of the orbit in loose fat in front of the medial end of the superior orbital fissure. Classically it lies between the optic nerve and lateral rectus, usually lateral to the ophthalmic artery [1]. The mean distance between the ganglion and the optic nerve is 2.9 mm and the mean distance between the lateral rectus muscle and the ganglion is 10.4 mm. The short ciliary nerves arise from the ganglion and run forward in a curving manner with the ciliary arteries above and below the optic nerve [2]. Usually, to locate this ganglion, it is advised to find first, the nerve to the inferior oblique muscle, along the inferior border of the lateral rectus, and follow it backwards up to the motor root.

It has been reported that in some cases parasympathetic roots were missing and the ganglion was attached directly to the inferior branch of the oculomotor nerve or the nerve to the inferior oblique muscle. Most of the short ciliary nerves entered the eyeball in its temporal aspect. Only 1–2 short ciliary nerves entered the medial aspect after crossing the optic nerve inferiorly [3].

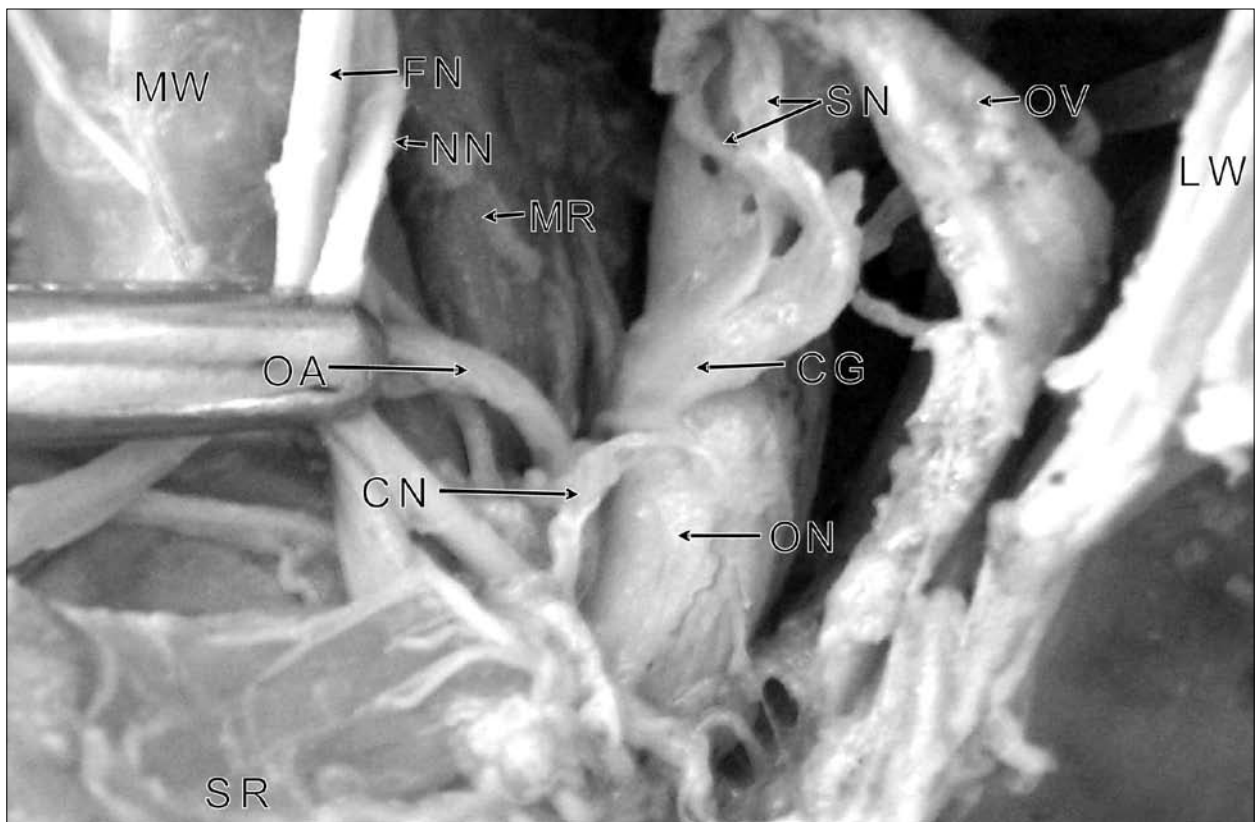
The accessory ciliary ganglion was identified in 13 different species (pig, sika deer, domestic sheep, horse, cat, fox, racoon dog, marten, rat, rabbit, crab-eating macaque, Japanese macaque and man), although the

number and degree of development varied greatly from species to species. The accessory ciliary ganglion can be readily differentiated from the main ciliary ganglion by its location on the short ciliary nerve. In few species, there were one or more small ganglia on the nerve to the inferior oblique muscle [4].

### Case Report

This unilateral positional variation was observed in right orbit of 62 year old, south Indian female cadaver, during routine dissection schedule for the medical students at Kasturba Medical College, Manipal, India.

In this female cadaver, we found the ciliary ganglion positioned between the optic nerve and medial rectus muscle, lateral to the ophthalmic artery and in close contact with the later. The ganglion was placed superomedial to the optic nerve near the apex of the orbit, under the superior rectus muscle. The sensory root from the nasociliary nerve and sympathetic root from the internal carotid plexus were running above the optic nerve and joining the ganglia. The parasympathetic root for the ganglion was coming from the inferior branch of the oculomotor nerve below the optic nerve. The short ciliary nerves usually pierce the temporal side of the sclera, were arranged in two bundles and were running above the optic nerve before piercing the sclera only superomedial to the optic nerve (Figure 1). There was no accessory ciliary ganglion. On the other hand, in the left side, the position, branching pattern of the ciliary ganglion and its relation to other intraorbital structures



**Figure 1.** Positional variation of the ciliary ganglion. Ciliary ganglion (CG) was found between optic nerve (ON) and medial rectus (MR), lateral to and in close proximity to the ophthalmic artery (OA). A communicating nerve (CN), sensory root from the nasociliary nerve (NN) was joining the ciliary ganglion superomedial to optic nerve. Two bundles of short ciliary nerves (SN) were running superior to optic nerve and piercing the sclera above the optic nerve. (SR: superior rectus; FN: frontal nerve; MW: medial wall of the orbit; LW: lateral wall of the orbit; OV: superior ophthalmic vein)

were normal. A section of the ganglion was then stained and histologically studied. It revealed the presence of nerve cell bodies, fat tissue and few blood vessels.

#### Discussion

The ciliary ganglion can easily be injured during surgical intervention for the repair of orbital fractures, intraorbital mass lesions, cavernous angiomas, hydatid cyst, and in other orbital traumas and lesions. In most of the cases the ciliary ganglion is placed lateral to the optic nerve, thus, special care should be taken during lateral approaches to the orbit and the patients should be warned before the surgery about possible mydriatic or tonic pupils as a complication [2].

In the ciliary ganglion, most of the post-ganglionic fibers innervate the ciliary body for accommodation; the remaining few fibers innervate the iris sphincter for miosis during the light reflex. When the ciliary ganglion is damaged, there is an aberrant regeneration of fibers and innervation of intraocular muscles is impaired. Thus, light response is diminished, but accommodative near constriction remains. However, near constriction is often slow and segmental, and accommodation is often diminished. This condition is called tonic pupil. Tonic pupils are usually due to Adie syndrome, but, peripheral neuropathies (such as diabetic neuropathy), herpes

zoster viral attack on ciliary ganglion, giant cell arteritis, surgical intervention of orbital cavernomas and traumas to the orbit can also produce tonic pupil. Anything that denervates the ciliary ganglion will produce a tonic pupil due to aberrant nerve regeneration. The incidence of tonic pupil is more with the history of local trauma or orbital surgery.

To reach intraorbital/retrobulbar/intraconal space, in order to repair orbital fractures, to manage intraorbital lesions and traumas, many microsurgical approaches have been suggested; medial approach [5], approaches to the medial part of superior orbital fissure [6], lower fornix approaches for large intraconal tumors of the orbit [7], transnasal and transantral endoscopic surgical approaches in the management of apical orbital lesions [8], transcranial approaches [9], lateral approaches [10], endoscopic intraethmoidal approaches [11], transcranial approaches to reach optic nerve [12], deep transorbital approaches to reach apex of the orbit [13], transconjunctival approach [14]. The present positional variation, medially placed ciliary ganglion is important and should be taken into account during these types of approaches to avoid damage to ciliary ganglion and its further consequences.

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