



Characteristic anatomical structures of rat temporal bone

Peng Li ^{a,b}, Kelei Gao ^{b,c}, Dalian Ding ^{a,b,c,*}, Richard Salvi ^{b,c}

^a Department of Otolaryngology, Head and Neck Surgery, The Third Affiliated Hospital, Sun Yat-Sen University, Guangzhou 510630, China

^b Center for Hearing and Deafness, State University of New York at Buffalo, Buffalo, NY 14214, USA

^c Department of Otolaryngology, Head and Neck Surgery, Xiangya Hospital, Central South University, Hunan 410013, China

Abstract

As most gene sequences and functional structures of internal organs in rats have been well studied, rat models are widely used in experimental medical studies. A large number of descriptions and atlas of the rat temporal bone have been published, but some detailed anatomy of its surface and inside structures remains to be studied. By focusing on some unique characteristics of the rat temporal bone, the current paper aims to provide more accurate and detailed information on rat temporal bone anatomy in an attempt to complete missing or unclear areas in the existed knowledge. We also hope this paper can lay a solid foundation for experimental rat temporal bone surgeries, and promote information exchange among colleagues, as well as providing useful guidance for novice researchers in the field of hearing research involving rats.

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Keywords: Rat; Temporal bone; Anatomy

1. Introduction

Through extensive experimental studies, functions and structures of most organs of the rat as well as its gene sequences have been well established, and rats are now widely used in various experimental medical studies. In the field of inner ear research, rats are used to study injuries to the inner ear by various agents including aminoglycoside antibiotics, platinum anti-cancer drugs, anti-malaria drugs, herbicides, insecticides, anti-inflammatories, loop diuretics, blast waves, noises, high-frequency electromagnetic radiation and heavy metals (Ding et al., 2012a, 2004, 2013a, 2009a; Ding and Salvi, 2005; Ding et al., 2009b, 2011a, 2011b, 2012b, 2013b, 2014a; Ding et al., 2014b; Fu et al., 2012; Liu et al., 2014, 2011; Nicotera et al., 2004; Qi et al., 2008; Wei et al.,

2010a, 2010b; Wu et al., 2011; Kraus et al., 2011; Allman et al., 2011; Ewert et al., 2012; Mencher et al., 1995). A good understanding of the unique characteristics of rat temporal bone anatomy and exploration of surgical approaches for inner ear drug delivery and electrode insertion are essential for experimental research of the ear in rats. Temporal bone anatomy has been extensively described in humans and other mammals including the rat (Ding and Jiang, 1989; Ding et al., 2010, 2001; Gulya and Schuknecht, 1995; Schuknecht, 1974; Engstrom, 1951; Engstrom et al., 1972; Engstrom and Engstrom, 1971; Engstrom et al., 1979; Engstrom and Sjostrand, 1954; Hellstrom, 1982; Judkins and Li, 1997; Yang et al., 1985; Zhang et al., 2008; Huang et al., 2003; Wang et al., 2008), but still there lacks descriptions of some detailed yet important features in the rat temporal bone and some of the existed descriptions are not necessarily accurate. This paper intends to provide a detailed description of various parts of the rat temporal bone with diagrams to fill some of the blank spots in the knowledge of rat temporal bone anatomy. It also serves as a foundation of our next paper in a series of papers that introduces various surgical approaches for middle and inner ear surgeries in rats. We also hope that the

* Corresponding author. Department of Otolaryngology, Head and Neck Surgery, The Third Affiliated Hospital, Sun Yat-Sen University, Guangzhou 510630, China.

E-mail address: dding@buffalo.edu (D. Ding).

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information in this paper will help novice researchers in the field familiarize with the rat temporal bone anatomy.

2. Surface landmarks of rat temporal bone

The rat temporal bone shares similar structures with other mammals, including the squamosal, petrosal, tympanic and mastoid bones. The temporal bone is on the lateral side of the skull and contributes to the formation of the middle and posterior cranial fossas of the lateral skull base. It borders the parietal bone superiorly, sphenoid bone medially and inferiorly, zygomatic bone anteriorly and occipital bone posteriorly (Fig. 1A–F).

The lateral side of the temporal bone is comprised of the lateral side of the squamosal, tympanic and mastoid bones. The squamosal bone comprises the superior and anterior part of the temporal bone and borders the parietal, tympanic and mastoid bones. Anteriorly and inferiorly, its zygomatic process connects with the temporal process of maxilla bone to form the zygomatic arch. The posterior extension of the zygomatic process is called the temporal crista, where the temporalis muscle attaches. The tympanic bone forms the middle and lower part of the temporal bone, consisting of the tympanic bulla as well as the bony external auditory canal. It is connected to the squamosal and mastoid bones supero-anteriorly

and posteriorly, respectively (Fig. 1A). The lateral wall of tympanic bulla forms part of the floor, roof and anterior wall of the bony auditory canal, while the supero-posterior wall of the canal is formed by the infero-posterior portion of the squamosal bone and anterior portion of the mastoid bone. Due to the more laterally protruding position of the bulla lateral wall as compared to the lower rim of the squamosal bone and the anterior rim of the mastoid bone in forming the ear canal, the opening of the bony canal is a ring of three quarters. Inferior and posterior to the ear canal, there is a bony prominence which is part of the lateral wall of the tympanic bone, but not part of the mastoid bone, different from the human temporal bone (Fig. 1B). The mastoid bone in rat connects with the squamosal bone supero-anteriorly, with the superior occipital bone infero-posteriorly, with the posterior portion of the tympanic bone infero-anteriorly and with the lateral occipital bone infero-posteriorly, with its lateral wall appearing as a diamond shaped plate surrounded by the aforementioned bones (Fig. 1B). Its rough surface indicates attachment of the sternomastoid muscle. Its lateral wall is thin and contains no air cells. On its inner side is the subarcuate fossa of the posterior fossa that houses the flocculonodular lobe of the cerebellum. There is no stylus process in rat temporal bone, but a paracondylar process behind the mastoid bone that originates from the occipital bone (Fig. 1A and C). Between the ear canal

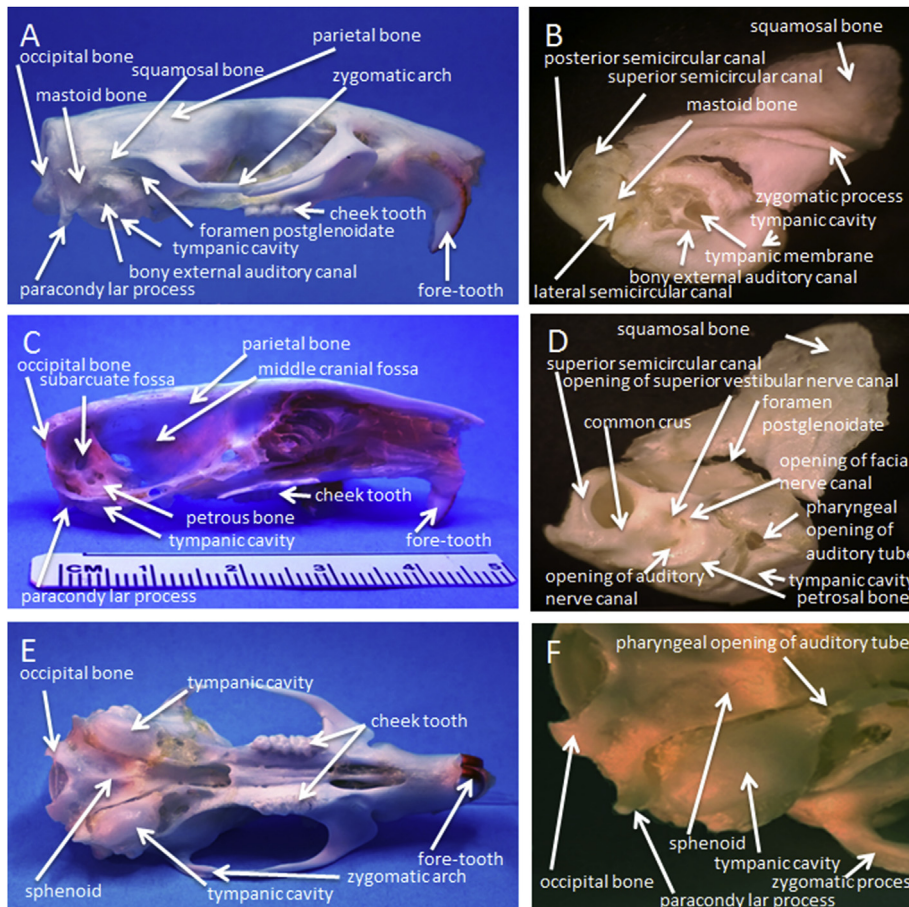


Fig. 1. Landmarks of rat temporal bone. A. Lateral view of rat cranium. B. Lateral view of rat temporal bone. C. Inside view of rat cranium. D. Medial side of rat temporal bone. E. Bottom of rat cranium. F. Bottom view of rat temporal bone.

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