

Development of the Pediatric Temporomandibular Joint



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KEYWORDS

• Temporomandibular joint • Mandible • Embryology • Temporal bone • Glenoid fossa

KEY POINTS

- The anatomy of the temporomandibular joint (TMJ) consists of a disc, articular surfaces, a joint capsule, synovial fluid, cartilage, and ligaments. Each TMJ is reliant on these structures and depends on the opposing TMJ to facilitate appropriate mandibular function.
- The TMJ is unique in comparison with other synovial joints in its embryologic derivation and in terms of its later onset of development and the amount of growth still required postnatally.
- The TMJ is derived from the first pharyngeal arch; normal embryologic development consists of 3 stages: the blastemic stage, cavitation stage, and maturation stage.
- The development of the TMJ is an intricate process reliant on separate but coordinated processes involving both the temporal bone and mandible. Therefore, nearby structures with similar developmental origins can manifest malformations along with the TMJ.
- When the TMJ is malformed, both form and function have multiple implications that will need to be addressed over time.

INTRODUCTION

The temporomandibular joint (TMJ) is a diarthrotic or synovial joint; it is the most prevalent type of joint in the human body. It contains a synovial cavity, fibrous joint capsule, and articular cartilage.¹ Synovial joints are further classified according to structure and function. The TMJ is a ginglymoarthrodial joint, as it is able to perform hinge and gliding motions.^{1,2} The TMJ is distinct from other synovial joints in that it is formed by 2 separate mesenchymal tissues. Most other synovial joints are formed by cleavage or segmentation within a single condensation.^{3,4} It also develops last in utero and is relatively

underdeveloped in comparison with other synovial joints at birth.⁵

The articular surface of the TMJ has fibrocartilage that contains both elastic and collagen fibers.¹ This fibrocartilage provides resilience against high-pressure occlusal forces.² The TMJ plays a critical role in facilitating range of motion of the jaw to allow for speech, mastication, respiration, and swallowing.² As initial sucking motion develops into chewing motion, the development of the TMJ continues to accommodate changing function.⁵ The location of the TMJ, between the base of the skull and the mandible, determines its development and proper function. In this article, the authors review the development of the TMJ

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from birth to adulthood and the clinical implications of TMJ maldevelopment.

Anatomy of the Temporomandibular Joint

The TMJ is composed of a disc, articular surfaces, a joint capsule, synovial fluid, a synovial membrane, cartilage, and ligaments.⁵ The cranial surface of the TMJ is composed of the squamous portion of the temporal bone. The concavity along the surface of this bone is known as the glenoid fossa. The posterior portion of the glenoid fossa is known as the posterior articular ridge. There is a laterally based projection off of this ridge that is called the postglenoid process (PGP).⁵ The posterior portion of the glenoid fossa also contributes to the superior wall of the external auditory meatus. The anterior boundary of the glenoid fossa is formed by the articular eminence (AE). The AE is a transverse bony prominence that is medial to the posterior border of the zygomatic process.⁵ The preglenoid plane is a gentle sloped area that leads into the AE and is located just anterior to the fossa along the skull base. This area facilitates movement of the disc and condyle during wide mouth opening.⁵ There is a small bony ridge at the lateral aspect of the AE, at the junction with the inferior aspect of the root of the zygomatic process, that is known as the articular tubercle. This ridge is an attachment point for the lateral collateral ligament.⁵ The lateral border of the glenoid fossa is on a slightly raised plane. It curves medially in an anterior to posterior direction until connecting to the PGP.⁵ The fossa is wider mediolaterally when compared with the anteroposterior width.⁶ The inferior articular surface is the superior aspect of the mandible. It is composed of an ovoid condylar process that is 15 to 20 mm wide in transverse direction and 8 to 10 mm wide in the anteroposterior direction⁷ (Fig. 1).

The articular disc is biconcave with a round or oval shape. It is located between the condyle and the glenoid fossa. The disc is composed of an anterior band, thin intermediate zone, and posterior band.⁸ Its anterior portion is approximately 2 mm in thickness and consists of a superior fibroelastic layer and an inferior fibrous layer⁵ (Fig. 2). The superior layer attaches to the PGP and prevents slipping of the disc with wide mouth opening. The inferior portion of the disc prevents excessive rotation of the disc over the condyle. The anterior portion of the disc attaches to the joint capsule, condylar head, AE, and superior belly of the lateral pterygoid muscle.⁸ The posterior band is thicker at 3 mm.⁸ It attaches to the bilaminar retro-discal tissue located posterior to the condyle within the glenoid fossa that in turn connects to

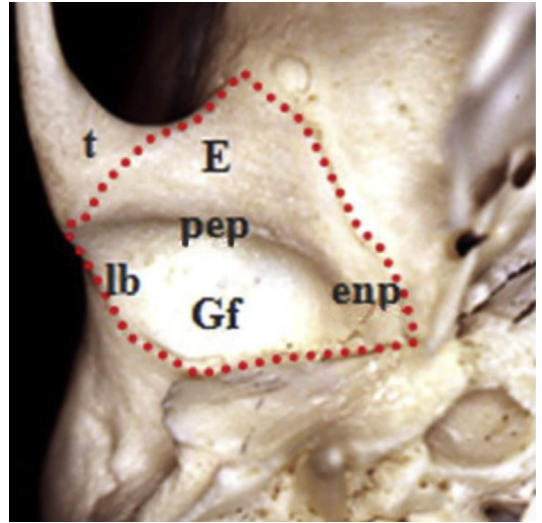


Fig. 1. Caudal cranial view of the temporal aspect of TMJ. E, articular eminence; enp, ento-glenoid process; Gf, glenoid fossa; lb, lateral border; pep, postglenoid process; t, articular tubercle. (From Alomar X, Medrano J, Cabratosa J, et al. *Anatomy of the temporomandibular joint*. *Semin Ultrasound CT MR* 2007;28:170; with permission.)

both the condyle and temporal bone.⁸ The medial and lateral aspects of the disc are attached firmly to the condyle⁵ (Fig. 3).

Development of the Temporomandibular Joint

At 8 weeks' gestation, most other joint cavities are present in their initial form; but the TMJ develops later, and at this time there are only the embryologic condensations of the condyle, temporal

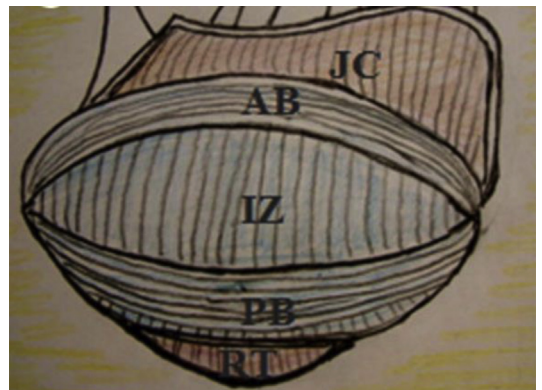


Fig. 2. Articular disc of TMJ. AB, anterior band; IZ, intermediate zone; JC, joint capsule; PB, posterior band; RT, retro-discal tissue. (From Alomar X, Medrano J, Cabratosa J, et al. *Anatomy of the temporomandibular joint*. *Semin Ultrasound CT MR* 2007;28:173; with permission.)

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