

The partial labyrinthectomy petrous apicectomy approach to petroclival meningiomas. A quantitative anatomic comparison with other approaches to the same region

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Summary

The partial labyrinthectomy petrous apicectomy (PLPA) approach is a transpetrous route that provides the advantages of the labyrinthine removal but with hearing preservation. Using seven temporal bone tissue blocks and three formaldehyde-fixed cadaveric heads we have made a morphometric and comparative study on this approach that summarizes the invasiveness, the optimal surgical exposure, the anatomic complexity of the skull base approaches and, on the other hand, the spirit of preservation that is the constant aim of modern neurosurgery. The morphometric analysis is designed to make the bony phase of the PLPA approach safer and to define the relationship between petrous landmarks. The comparative study is made between the PLPA and other neurosurgical routes enhancing the potentiality of the PLPA approach that permits a wider angle of incidence towards the brainstem than with the retrosigmoid routes.

KEY WORDS: Meningioma. Partial labyrinthectomy. Petroclival. Petrosal approach. Rretrosigmoid approach.

La laberintectomía parcial con apicectomía petrosa como acceso a los meningiomas petroclivales. Una comparación anatómico - cuantitativa con otras vías de abordaje a la misma zona

Resumen

La laberintectomía parcial con apicectomía petrosa (PLPA) es una vía de abordaje que proporciona las ventajas de la extirpación parcial del laberinto preservando la audición. Trabajando sobre 7 piezas anatómicas de hueso temporal y 3 cabezas de cadáver fijadas con formaldehído, hemos realizado un estudio morfométrico y comparativo de este abordaje interesándonos los aspectos de la invasividad del abordaje, óptima expo-

sición quirúrgica obtenida, complejidad anatómica de la entrada a la base craneal, y por otra parte, la actitud conservadora de la moderna neurocirugía. El análisis morfométrico tiene como objetivo hacer la fase ósea de la PLPA más segura al definir la relación entre los puntos de referencia petrosos. El estudio comparativo entre la PLPA y otros abordajes neuroquirúrgicos exalta la posibilidades de la PLPA ya que proporciona un ángulo de incidencia hacia el tronco cerebral más amplio que el que proporcionan las vías retrosigmoideas.

PALABRAS CLAVE: Meningioma. Laberintectomía parcial. Petroclival. Abordaje petroso. Abordaje retrosigmoideo.

Introduction

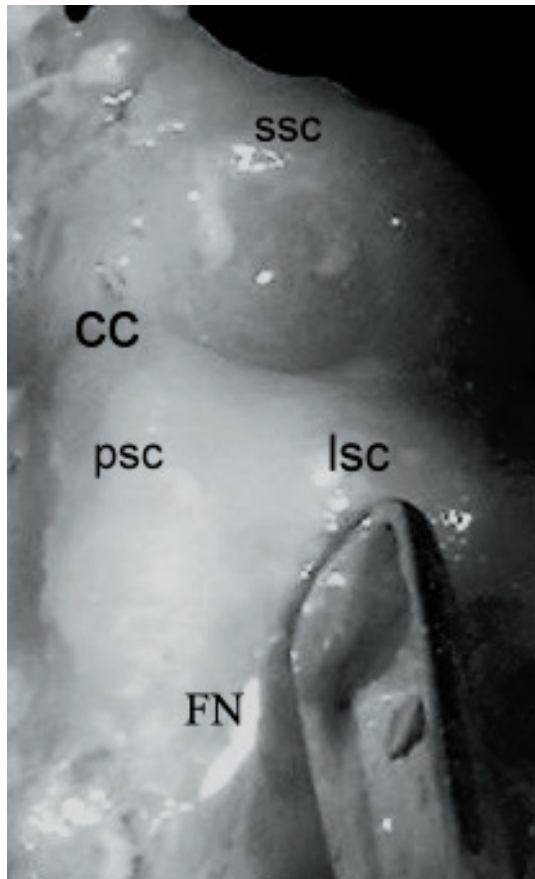
The partial labyrinthectomy petrous apicectomy approach (PLPA) or transcrusial approach⁶ is a relatively new surgical route to the petroclival region^{4,6,16,17}.

It has the advantages of exposure linked to the transpetrous corridor but with minimal post-operative morbidity resulting from manipulation of the anatomic structures in the way. This approach provides a transpetrous corridor for removing the mastoid, the superior and posterior semicircular canals and the petrous apex but without hearing loss.

This morphometric anatomic study on the PLPA bony phase was designed to collect and relate the surgical landmarks useful to the surgeon during this difficult phase. We also wanted to make quantitative measurements on the osteo-dural and nervous surfaces for this approach, comparing them with others obtained by currently popular surgical routes in order to evaluate the different degrees of each surgical exposure. The other approaches considered

Abbreviations. EAC: external auditory canal. ETCA: enlarged transcochlear approach. FN: facial nerve. ICA: internal carotid artery. PLPA: partial labyrinthectomy petrous apicectomy. RISTA: retrosigmoid intradural suprameatal transpetrous apex. RS: retrosigmoid. SD: standard deviation. SS: sigmoid sinus.

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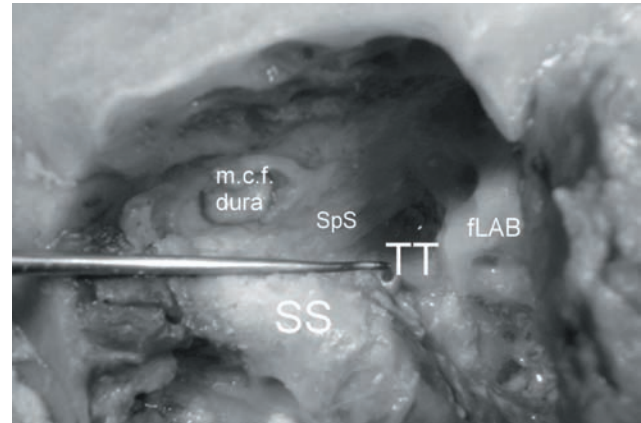
ssc: superior semicircular canals. *lsc*: lateral semicircular canals. *psc*: posterior semicircular canals. *CC*: common crus. *FN*: facial nerve.

Figure 1. The superior, lateral and posterior semicircular canals with the common crus are skeletonised. The dissector shows the relationship between the *lsc* and the third segment of the facial nerve. The covering bony shell has been partially removed to point out the *FN*. (right site).

are the sub-occipital retrosigmoid approach (RS), the retrosigmoid intradural suprameatal transpetrous apex approach (RISTA) and the combined enlarged transcochlear approach (ETCA).

The least invasive approach is the RS^{11,18}; this is the classic neurosurgical route to the cerebello-pontine angle which implies a retrosigmoid craniectomy and its surgical light is along the posterior petrous surface. The RISTA is an extension of the RS approach, through an intradural apicectomy^{12,19}.

Finally, the ETCA, executed according to the cadaveric studies of Sanna et al.¹⁴, is one of the most invasive skull base approaches in which the surgical corridor is through the petrous bone after complete mastoidectomy, with posterior transposition of the third segment of the facial nerve (FN) and radical removal of the otic capsule and apicectomy.



SpS: superior petrosal sinus. *fLAB*: fenestrated labyrinth. *SS*: sigmoid sinus. *TT*: Trautmann's triangle. *m.c.f. dura*: medial cranial fossa dura.

Figure 2. The area of the posterior fossa dura enclosed between the superior petrosal sinus, the jugular bulb, the labyrinth and the sigmoid sinus is represented. It corresponds to the Trautmann's triangle.

tomy.

Materials and methods

Seven tissue blocks (four right and three left) were removed from cadavers with no history of disease involving the central nervous system or skull base. There were five males and two females, aged 57 to 79 years [mean 63.3 years; standard deviation (SD) 7.5 years]. Each specimen included the temporal bone, sella turcica, part of the clivus, homolateral sigmoid sinus (SS), homolateral transverse sinus, dura mater covering the endocranial surface of the skull base, the muscles of the infratemporal fossa inserted on the lateral cranial base, and the ascending branch of the mandible. The internal carotid artery (ICA) and the jugular vein were washed with hot tap water then injected with colored silicone (red for the artery and blue for the vein). Each specimen was preserved in 66% ethanol solution for 24 hours before being dissected¹³. The tissue blocks were placed in the surgical position used for the PLPA. The dissection and measurements were made under magnification using the operative microscope (Leica MS®, Switzerland).

The mastoid was drilled until all three semicircular canals and the vertical segment of the FN were exposed (Fig 1). Identification of the superficial anatomic landmarks was the key point for the first phase of the procedure^{10,14,16,17}.

The following landmarks were considered: the floor of the middle cranial fossa, the tip of the mastoid, Macewen's triangle (suprameatal triangle) and Henle's spine, the external auditory canal (EAC), the sinodural angle (SDA: the

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