Anterior cervical microsurgical approach to the cranial base in the rabbit: technical note

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Summary
Current trends in research on craniofacial syndromes have led to enhanced interest in the cranial base as a contributory factor in the development of normal and abnormal midfacial structure. Indeed, attention has focused upon one particular growth plate in the posterior cranial base, the sphenooccipital synchondrosis, since it has been shown that alterations in this structure are associated with profound changes in craniofacial growth. In this report we describe a surgical approach to the cranial base of the rabbit that is safe, simple and reliable. It is applicable to neonatal as well as adult rabbits.

Keywords: Cranial base; Sphenooccipital synchondrosis; Cranial synostosis; Rabbit

Recent advances in instrumentation and surgical microscopy have enabled the reconstructive surgeon and the neurosurgeon to perform complex craniofacial reconstructive procedures which would have been impossible a decade ago. Innovative modalities for evaluating complex congenital malformations, such as 3-dimensional CT imaging, have given us new insights into the patterns of normal and abnormal facial growth. The work of multiple authors has suggested that one of the unexplored margins of the face, namely the basicranium, may play an important role in facial development (Moss, 1959).

Virtually all studies investigating calvarial bone growth have used the rabbit model as the standard (Persson et al., 1979; Persing, 1986). Data from these studies supports the long-held contention that growth of the cranial vault and face is multifactorial and no single model fully explains the complex anomalies seen in craniofacial synostosis. It has been suggested by Tessier, Moss and others that abnormalities involving the cranial base play a significant role in the development of craniosynostosis (Moss, 1959; Tessier, 1971). There presently does not exist a single controlled study which investigates basicranial fusion and its implications on calvarial or facial growth. The present technique was developed for exposure of the cranial base in rabbits. It provides excellent visualization of the anterior intersphenoidal synchondrosis (AIS) and the posterior sphenooccipital synchondrosis (PSOS), thus enabling further research into this region which is very difficult to expose surgically. The procedure is safe, relatively facile and well tolerated in both adult and immature animals.

Materials and methods
New Zealand White rabbits (Oryctolagus cuniculus) were obtained from commercial conventional colonies (Hazleton, Denver, PA, USA) and maintained in a controlled environment (20 °C, 50% humidity, 12:12 h artificial light/dark cycle, 4·2 ft² stainless steel cages from Wahman Manufacturing (Baltimore, MD, USA)). All were fed pelleted rabbit chow (Purina High Fiber Rabbit chow No. 5326, Purina Inc., Richmond, IN, USA) with water available ad libitum.

Each rabbit (10 total, ranging in age between 9 and 30 days) was anaesthetized with an
intramuscular injection of ketamine hydrochloride (35 mg/kg) and xylazine (15 mg/kg). Maintenance dosage of one-half loading dose of ketamine was administered every 20–40 min during the procedure as needed to maintain surgical anaesthesia. Kefzol (50 mg/kg IM) was given preoperatively as single dose prophylaxis. The anterior cervical region of the rabbit was then shaved after the animal was placed on a cork board in the supine position with the neck extended. The head was positioned slightly beyond the edge of the operating table, thus allowing gravity to maintain this hyperextended posture. The limbs were secured in the fully extended and abducted position with rubber bands and tacks upon the cork board. The neck was then prepared with an alcohol solution and draped in a standard sterile fashion.

Using loupe magnification, a 3 cm midline incision was made and carried through the platysma and superficial cervical fascia. An adjusted finger retractor was then placed (Fig. 1). A bipolar cautery device was used to maintain haemostasis. The sternocleidomastoid muscle was reflected laterally and held by the retractor, and with blunt dissection, a plane was easily created in the deep cervical fascia between the carotid sheath and the trachea and oesophagus. Using the tip of a No. 11 scalpel blade, a transverse incision was made in the trachea, below the level of the hyoid bone. A 1–3 cm segment of clear IV tubing with the distal edge slightly bevelled was inserted into the trachea as a temporary tracheostomy tube (Fig. 2). Standard IV tubing works well in rabbits weighing over 300 gm. In smaller rabbits, an appropriate segment of tubing from a butterfly catheter (16, 20 or 23 gauge) suffices. No stay sutures were necessary. This tubing ensures an adequate airway and allows the surgeon continuous visualization of air exchange and depth of anaesthesia (e.g. respiratory rate) during the procedure.

Full exposure of the deep cervical fascia and paravertebral fascia was then facilitated by placement of a self retaining retractor in the groove between the trachea and the carotid sheath. Below this fascia are the longus coli muscles (Fig. 3). In the midline, adjacent to the longus coli, there lies a dense network of venous channels. A bipolar cautery was used to obliterate these vessels and allow the longus coli and longus capitus muscles to be stripped from their insertion on the skull base. This exposed the basal surface of the occipital and sphenoid bones (Fig. 4). By curettage of the surface of the

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Fig. 1. Exposure of the precervical fascia.
skull base, the grey cartilagenous plates of the AIS and PSOS were identified. The tracheostomy was closed with 6-0 Nylon suture and the sternocleidomastoid was re-approximated in the midline with 4-0 Vicryl suture. Skin was closed with a running 5-0 Nylon.

The rabbit was allowed to spontaneously recover from anaesthesia in its cage with a heating lamp placed above. Most importantly, a suture was placed through the tip of the tongue for forward traction to prevent glossoptosis and asphyxiation. This was removed without discernible pain before recovery from
anaesthesia. Several hours later the animal was active showing no untoward signs.

**Results and discussion**

The technique described here is a modification of one used by Rosenblum and Oldfield (1987) to approach the pituitary and infundibulum in primates and earlier by Smith (1930). The present procedure is rapid, easy to perform, and well tolerated in the rabbit. A stereotactic frame is unnecessary as simple gravitational extension of the neck gives excellent exposure. No adjacent structures are damaged in the procedure, thus allowing further basicranial research.

**References**


Smith P (1930) Hypophysectomy and a replacement therapy in the rat. *American Journal of Anatomy* 45, 205–256