Color Atlas of Microneurosurgery of Acoustic Neurinomas

Endoscope-Assisted Techniques • Neuronavigational Techniques • Radiosurgery

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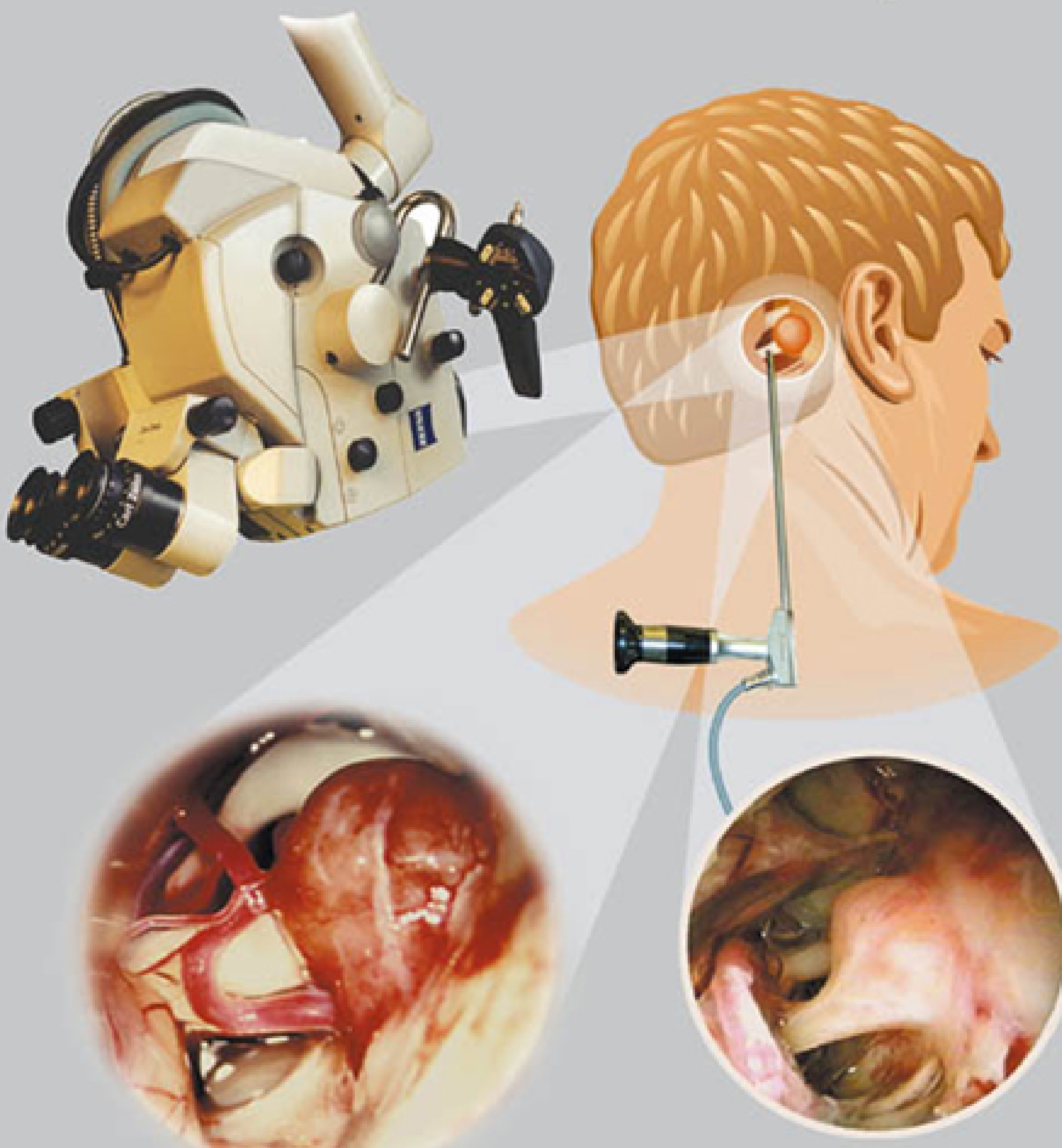

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Foreword

Surgery in the cerebellopontine angle is coveted like few other microneurosurgical procedures. Both the elegance of the surgical approaches to this region of the brain and the beauty of its anatomy are, in and of themselves, rewarding for surgeons. When coupled with excellent patient outcomes in the hands of expert surgeons, the allure and prestige of surgery for acoustic neurinomas is understandable. Against this backdrop, Koos and his colleague Matula embarked on the arduous task of producing a book that would stand apart as a work of value to the neurosurgeons who treat these lesions but who are at various stages in their careers. They have succeeded admirably with their final product.

This work is primarily an atlas, but it is complemented throughout by the text needed to convey essential information to the reader. The quality of both the photographic plates and the line drawings is of the highest caliber. Equally important is the superb organizational structure, which allows both the neophyte and the veteran to extract relevant information quickly.

The book proceeds logically from a concise *Introduction and History* in Chapter 1 to surgically relevant *Microanatomy of the Cerebellopontine Angle* in Chapter 2. The anatomy of this region is conveyed to the reader by the many images showing the cerebellopontine angle from various vantages. The section of Chapter 2 on the *Facial and Vestibulocochlear Nerves in Large Acoustic Neurinomas* is noteworthy for its photographs with color overlays, which aid in interpreting the intraoperative images, and in visualizing the relationship of large tumors to the surrounding cranial nerves. The brief third chapter, *Diagnosis,* is followed by *Microsurgery in the Cerebellopontine Angle* in Chapter 4. This chapter covers general surgical concepts, including a philosophy for determining the optimal treatment paradigm for a given patient (including radiosurgery and observation), anesthesiologic considerations, operating room set up, patient positioning, and approach.

Chapter 5, *Neurinomas of the Vestibular Nerves*, constitutes the main body of this work and contains a rich collection of well-illustrated case material. Preoperative radiologic studies, intraoperative photographs, and line drawings (both schematic and interpretive) of remarkable quality bring these cases to life, allowing the reader to benefit from the authors' vast clinical experience. Although not a replacement for personal clinical experience, exposure to this breadth and depth of case material will reinforce the experience of established surgeons and help provide a strong foundation for young surgeons beginning to develop their skill sets. Understanding the variations in the relationship of cerebellopontine angle tumors to surrounding structures is essential to performing safe, efficient, and effective surgery. The authors' experience greatly benefits the reader in this respect.

Chapters 6 through 11 cover other (and multiple) tumors of the cerebellopontine angle, reconstruction of the facial nerve, endoscopy, radiosurgery, and results and summary. Chapter 9 provides excellent examples of how the endoscope can be used to improve understanding of the relationship of the facial and cochlear nerves to the tumor before resection; this additional information can prove invaluable in helping to preserve these nerves in selected cases. Chapter 10, *Radiosurgery in Acoustic Neurinomas*, is a timely addition and helps place in perspective some of the issues surrounding patient selection for this emerging modality. The book ends with an extensive, well-referenced bibliography to guide the reader to the relevant primary literature.

The authors should be congratulated on their accomplishment. This text is both well conceived and well constructed. It should prove to be an invaluable resource to neurosurgeons who operate in the cerebellopontine angle.

Richard E. Clatterbuck

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Preface

The “Color Atlas of Microneurosurgery” series was produced to take into account the exciting number of changes that have occurred in neurosurgery, especially at the end of the last century. Is there any justification for such a special edition on a special topic from that series? Indeed, there is.

Advanced microsurgical instrumentation and techniques have led to a shift in goals in the treatment of acoustic neurinomas. Not only anatomic, but also more functional preservation of the cranial nerves—especially the eighth nerve—has become routine in experienced hands. In addition, minimally invasive techniques, such as endoscope-assisted procedures, have been established to achieve a further improved outcome. Planning each procedure individually through the use of neuronavigational systems and a clear intraoperative strategy should lead to perfect surgical handling. Indeed, the same reasons that compelled us to produce the “Color Atlas of Microneurosurgery” series, i.e. the introduction of new techniques and updating of old ones as well as the establishment of alternative treatment philosophies such as radiosurgery, have been the motivation for creating this special edition. Influenced by the success of the microneurosurgery series, this atlas is presented in a similar style. Although it is fair to say that a complex three-dimensional spatial task such as neurosurgery in the cerebellopontine angle can only be appreciated visually, contrary to the previous series much text is now included in the present atlas so that it has become a real textbook. After a short introduction and a brief excerpt about the history of microsurgical neuroanatomy, which constitutes the fundamental basis for carrying out these technically challenging operations, a separate subchapter addresses the special clinical anatomy of the seventh and eight nerve. Diagnosis is a strong point, as surgical strategies are planned according to the anatomic location and growth pattern of these tumors. The preoperative considerations, operating room set-up, patient positioning, and neuronavigational equipment as well as neuromonitoring and endoscope-assisted techniques are described for microsurgery in the cerebellopontine angle region. The operative techniques for removing acoustic neurinomas in correlation with size and extension of the tumor are provided in step-by-step detail using intraoperative photographs paired with explanatory line drawings. Tumors of the cerebellopontine angle that may mimic an acoustic neurinoma are also described. This compendium would not be complete if radiosurgery as an alternative method of treatment would not be discussed, especially when deciding what is best for the individual patient. Finally, the most important results are described, and a short summary is given as well as the most important bibliography dealing with the particular subject.

Once again, we must acknowledge the ideas and technical innovations of numerous colleagues from around the world, who are interested in this field and whose ideas have become ingrained in our own experience and are incorporated here. This atlas has benefited greatly from the technical expertise and critical suggestions of M. Tschabitscher of the First Department of Anatomy at the University of Vienna, whom we wish to thank. We are grateful to M. Reddy for her help with the manuscript. A tremendous amount of energy, time, and dedication on the part of Ingrid Dobsak has made this work possible. Without her constant self-sacrifice and understanding, this atlas would never have been completed. We express our thanks to the publishers, Thieme, above all to Mr. Krüger and his colleagues, for the superb quality of the production and the excellent cooperation in the preparation of this book. In particular, Mr. Cliff Bergman deserves recognition for his guidance, patience, prudence, and support during the growth of this atlas. We thank also Mr. Malik N. Lechelt for his support and belief in our work.

At the time we began to consider this project, W. T. Koos retired from his active work. When the final concept was agreed upon and the material was partially collected, he became seriously ill and died in 2000. It is with the deepest respect and a great sense of privilege that this work can now be a part in honoring the lifetime of experience of one of the giants in this field. We will never forget him!

Fall 2002 Christian Matula

Obituary: W. T. Koos (1930–2000)

W. T. KOOS (1930–2000)
Professor of Neurosurgery
Professor and Chairman
Department of Neurosurgery, 1978–1998

W. T. Koos was born in Vienna on February 14, 1930. His parents were both teachers. He remained in Vienna all of his formative years and was educated at the University of Vienna. Since his early days he exhibited a special interest in animals, encouraged by his grandfather, a passionate zoologist. During this time, noted author and conservationist Albert Schweitzer was his great idol and he hoped to follow his tradition as a naturalist.

He was later inspired by an article written by Harvey Cushing about the removal of brain tumors. This article had a profound effect on Koos, influencing the course of the rest of his professional life. He studied medicine and obtained his Doctor of Medicine degree from the University of Vienna in 1954. His first position as a neurosurgical resident was in Zürich under Professor Hugo Krayenbuehl. He then worked with the noted surgeon Professor Nissen in Basel for the following two years. After these initial surgical experiences, Koos realized that neurosurgery appealed to him above all else and sought an opportunity for first-rate neurosurgical training. This led him to Professor James Watts at the George Washington University, who accepted Koos into his neurosurgical training program. These were precious years that made a great impression upon Koos and introduced him to a much different life from the one he knew in his native Vienna. At the conclusion of his formal neurosurgical residency he spent time with various surgeons, including Kempe at the Walter Reed U.S. Army Hospital, William Sweet, and Wilder Penfield. He also traveled to Boston for special training in pediatric neurosurgery under Frank Ingraham and Donald Matson at Boston Children's Hospital.

Koos returned to his native Austria in June 1960 and began to establish neurosurgery, with an emphasis on pediatric neurosurgery, in Bad Ischl, located in the Oberösterreich district of Austria. After working there for three years he moved to Klagenfurt, the provincial capital of the Carinthia district of Austria. Here he was charged with establishing a neurosurgical department that would serve as the primary neurosurgical referral center for the entire region. He met this task with much enthusiasm and produced impressive results in his efforts to build his first department.

Koos' accomplishments in Klagenfurt captured the attention of Herbert Kraus, the first professor and chairman of the newly formed Department of Neurosurgery at the University of Vienna. Professor Kraus added Wolfgang to his staff, mainly focusing on establishing pediatric neurosurgery in Vienna. He worked there as a staff member and was promoted to Associate Professor in 1972. Koos was a driving force in the establishment of pediatric neurosurgery in

W. T. Koos

Europe during this time. Together with the German neurosurgeons Gerlach and Jensen, he wrote two books on this topic. Importantly he was a central figure in the founding of the European Society for Pediatric Neurosurgery, which held its inaugural meeting in Vienna in 1968.

During a visit to his former mentor Krayenbuehl in Zürich he met a brash young neurosurgeon named Gazi Yaşargil, who was recently returned from America where he worked with Donaghy. Koos was fascinated with the concept of using the new operating microscope, as Yaşargil had learned from Donaghy. Back in Vienna he introduced this new microsurgical technique and championed its routine use in cranial and spinal procedures.

He and his wife Ingrid decided to make a major change in their life in 1973, leaving their home of Austria for an opportunity to live in America. Koos joined the faculty at George Washington University, his former training center. Their stay in Washington D.C., however, was to be unexpectedly short. After only one year on the staff at GWU he was asked to return to Vienna. Professor Kraus had fallen ill from cancer and was unable to fulfill his duties as Chairman. Being loyal to his mentor and home, Wolfgang returned to Vienna to help manage the department. After Kraus' departure, Koos was appointed Professor and Chair of the Department of Neurosurgery in 1978.

Koos built upon the international reputation of the Department of Neurosurgery established by his predecessors in Vienna. His dream was to build an entirely new building that would house the complete department under one roof. He convinced the government of the necessity of such a center and was granted the funding for the project. Under his management and guidance the new building was constructed, opening its doors on December 14, 1984. Knowing that the new building was only the foundation piece for his department, he then directed his energies to creating one of the world's leading neurosurgical centers. He also recognized the importance of investing effort into the proper education of his students, hoping for them to become leading neurosurgeons around the world.

Koos was not a man to be satisfied with traditional methods. His career was marked by enthusiasm for developing new methods and applying cutting-edge technology to neurosurgery. Under his guidance Vienna became one of the first sites in Western Europe in 1993 to introduce contemporary radiosurgery by opening the Gamma Knife Center. In 1995 interventional neuroradiology became part of the building by opening a state-of-the-art endovascular operating theater. Until his retirement at the end of September 1998, he continued to work as a superbly skilled neurosurgeon. Koos was well known for his skull in acoustic neurinoma surgery, which was one of his primary clinical interests. He also continued to be interested in refining techniques for other intracranial tumors, cerebrovascular disease, and pediatric neurosurgery.

Altogether he published more than 200 scientific articles and edited several books, which have become neurosurgical standards around the world. Most notable of his books is the *"Color Atlas of Microsurgery"* series published by Thieme. Koos was a member of many of the world's leading scientific societies, including the American Association of Neurological Surgeons, Congress of Neurological Surgeons, The Royal society of Medicine, Societé de Neuro-Chirurgie de Langue Francaise, German and Austrian Society of Neurosurgery, European society for Pediatric Neurosurgery, and International Society for Pediatric Neurosurgery. From 1985 to 1988 he served as President of the European Society for Pediatric Neurosurgery and was President of the Austrian Society for Neurosurgery from 1989 to 1990.

Less than one year after he stopped active surgery, a terrible stroke forced him to stay hospitalized for months. Despite his condition, he put all his strength into his recovery and preparing the groundwork for the present book about his great clinical interest, microsurgery on acoustic neurinomas. After a courageous battle against the consequences of his illness, Wolfgang T. Koos passed away on March 31, 2000.

Organization of this Atlas

In general, we have attempted to publish the present book as a typical "atlas." In contrast to the previously published Color Atlas of Microsurgery Vols. I, II, & III, this atlas is organized around just one pathology. It was our intention to present this work in the form of a typical atlas, meaning we have tried to reduce the text to an absolute minimum of words. All the drawings, pictures, and graphs are mostly self-explanatory, however we have provided short descriptions of what we think are the most salient points.

Portions of this material have previously been published in prior books of our working group, namely "Color Atlas of Microneurosurgery Vol. I" (Koos, Spetzler, Lang) and "Color Atlas of Microneurosurgical Approaches" (Day, Koos, Matula). However, although this material is known to a number of neurosurgeons, this atlas has to be seen as a stand-alone edition. The intention of the authors is to provide a complete presentation about the surgical treatment of acoustic neurinomas.

Chapter one starts with a short introduction and a brief excerpt about history. Chapter two is devoted to the anatomy of the cerebellopontine angle and subdivided into two different parts. The first part presents the general anatomy of the cerebellopontine angle while the second part presents the special clinical anatomy and topography of the facial and vestibulocochlear nerves in large acoustic neurinomas. Chapter three covers diagnosis, including the special clinical studies necessary in cases of acoustic neurinomas. In the neuroradiological section of chapter three, the focus is more on magnetic resonance imaging (MRI), presenting the latest advances in this field. The last part of chapter three presents our protocol for handling these patients. Chapter four concerns microsurgery in the cerebellopontine angle starting with our general concepts. One of the most important questions today is whether the patient should be treated or a watch and wait strategy employed. If the patient needs to be treated, the treatment decision is between microsurgery versus radiosurgery. At the Neurosurgical Department in Vienna we are lucky to have both possibilities, therefore, we have tried to give some guidelines based upon our experience. The preoperative considerations and decision making follow the general section. Examples of questions we have attempted to give guidance to answering include, how to handle small neurinomas (grade I and II). What about acoustic neurinomas in the only hearing ear, especially in cases of bilateral acoustic neurinomas (Neurofibromatosis type II [NF II])? What about in cases of patients in a poor general clinical condition? We tried to answer these questions, and some simple algorithms are presented which could prove helpful in handling these patients. The next subpart of Chapter four concerns the selection of the patient's position on the operating table. Although in most of the cases the sitting position was used, there is also a brief discourse about alternative positioning like the modified park bench position. The selection of the surgical approach is also a subpart of chapter four, as well as the question of total versus subtotal removal.

Chapter four also deals with special neuroanesthetic considerations. First the use of transesophageal ultrasound in the sitting position for early detecting of air embolism is demonstrated. Second the use of intraoperative neuromonitoring for the VII and VIII nerve is discussed. The next subpart of this chapter is devoted to the operating room set up starting with a presentation of our equipment for surgery, anesthesia and documentation followed by a subdivision on neuronavigational equipment. The next subpart in this chapter is on equipment for drilling. Using the high-speed drill with good technique is one of the key points in successful microsurgery. The use of endoscope-assisted techniques is demonstrated in the following part of chapter four. In the last years special instruments have been developed specifically for this kind of microneurosurgery which are presented in the next part of chapter five.

Chapter five is devoted to clinical material. Starting with essential basic remarks, it covers tumor grading by size, origin and growth pattern of acoustic neurinomas, and operative techniques for removing acoustic neurinomas in correlation with the size and extension of the tumor. The cases presented start with the small acoustic neurinomas (grade I and II) followed by the large ones (grade III and IV). Each subdivision begins with a short introduction on general remarks and closes with the clinical cases as presented in previous books. In the case of small acoustic neurinomas, patterns and types, including special operative techniques, are also covered after the introduction. The last part of chapter five is dedicated to two different subdivisions, namely intracranial extrameatal acoustic neurinomas and recurrent neurinomas.

Chapter six of the present atlas is devoted to other tumors of the cerebellopontine angle like neurinomas of the facial nerve, the trigeminal nerve, and the glossopharyngeal nerve. Meningiomas, epidermoid cysts (cholesteatomas), choroid plexus papillomas, and arachnoid cysts follow this.

The following two chapters are organized in a very similar way to the previous one. Chapter seven focuses on multiple tumors of the cerebellopontine angle, presenting selected cases. Chapter eight deals with the intracranial reconstruction of the facial nerve.

Chapter nine deals with endoscopic methods in acoustic neurinoma surgery, starting with some principles in endoscope-assisted techniques followed by an explanation of the most important optical details relevant to the viewed structures. The most powerful advantages using these endoscopic techniques are highlighted.

Radiosurgery in acoustic neurinomas is the topic of chapter ten and it is our intent to present this technique as an alternative or additional treatment option.

Chapter eleven discusses our results using the strategy described in the previous chapters by demonstrating some illustrative tables and graphs and a short summary containing the authors' opinion.

Contents

1 Introduction and History

Acoustic neurinomas are well-known benign tumors that have fascinated generations of surgeons. They represent about 8–10 % of all intracranial tumors, with an incidence of around one case per 100.000 people. More than 95 % of these tumors are unilateral. The remaining patients with bilateral tumors have the pathognomonic signs of type 2 neurofibromatosis, a disease with autosomal-dominant inheritance. The three most common initial symptoms are hearing loss (about 95 %), tinnitus (about 70 %), and dysequilibrium (about 65 %). The growth rate of the tumors is unpredictable; some show no change over many years. It has been reported that as many as 6 % actually decrease in size without any treatment. On the other hand, some tumors can increase in diameter by up to 20 mm per year. The "typical" growth rate has been observed to be between 1–2 mm per year.

The clinical manifestations are so typical that this type of tumor was recognized quite early in medical history. One of the first descriptions appears to have been made in 1776 by Sandifort, in Leiden (Netherlands). He had no idea that this tumor was an acoustic neurinoma; he described a "little body hiding in the recess of the brain," and declared it to be the reason for the clinical symptoms. The first description of the clinical symptoms attributable to an acoustic neurinoma was made almost 50 years later by Levèque-Lasourie. Perhaps the most remarkable case was reported in 1835 by Cruveilhier (Fig. 1.**1**), who presented the clinical case of a 26-year-old woman in remarkable detail. Henneberg and Koch first introduced the term "cerebellopontine angle tumor" in 1902. Credit should be given to Monakow for being one of the first to conclude that surgical excision of acoustic nerve tumors should be possible. However, operations at that period where usually disasters, followed by postmortem descriptions. Finger dissection was the state-of-the-art technique at that time, and only three out of eight patients survived the operation. These techniques were both bloody and traumatic to all the structures around, especially the brain stem.

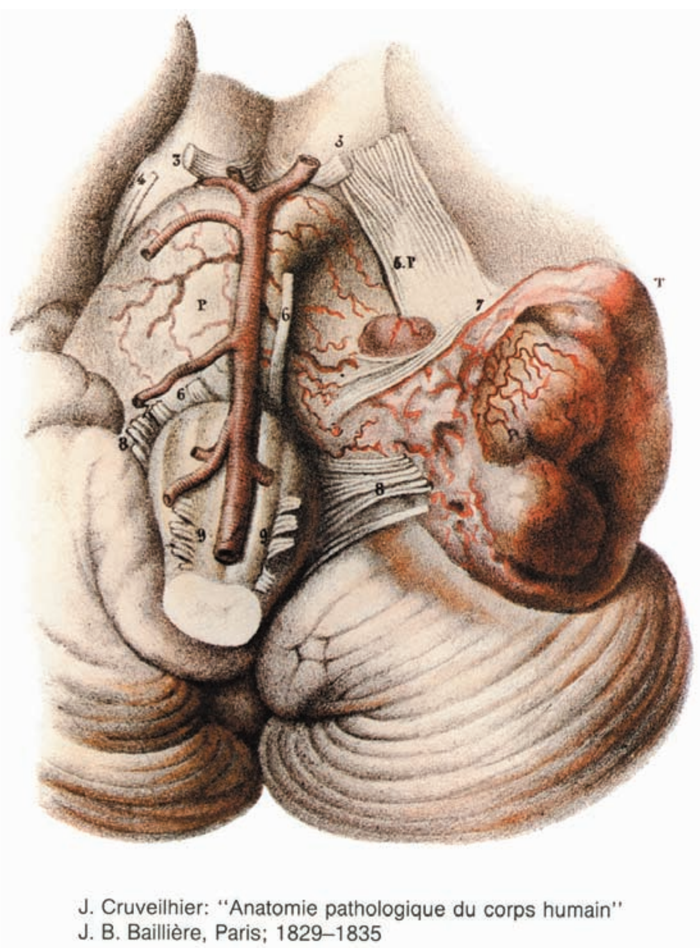
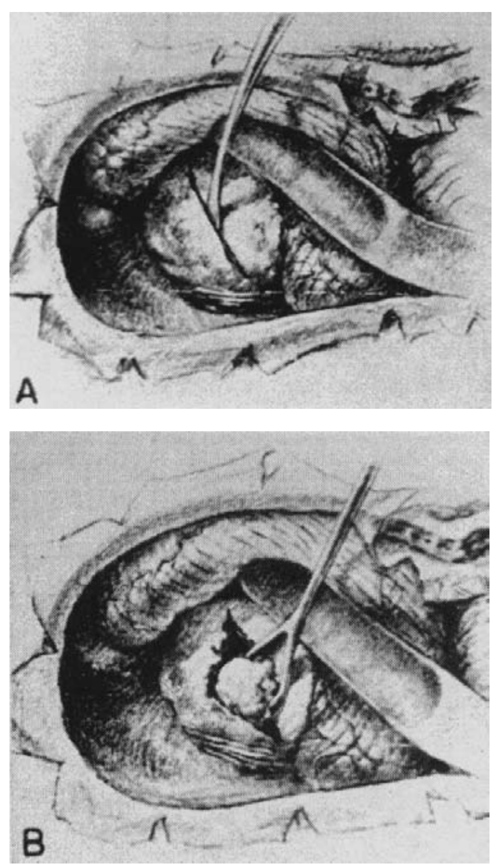
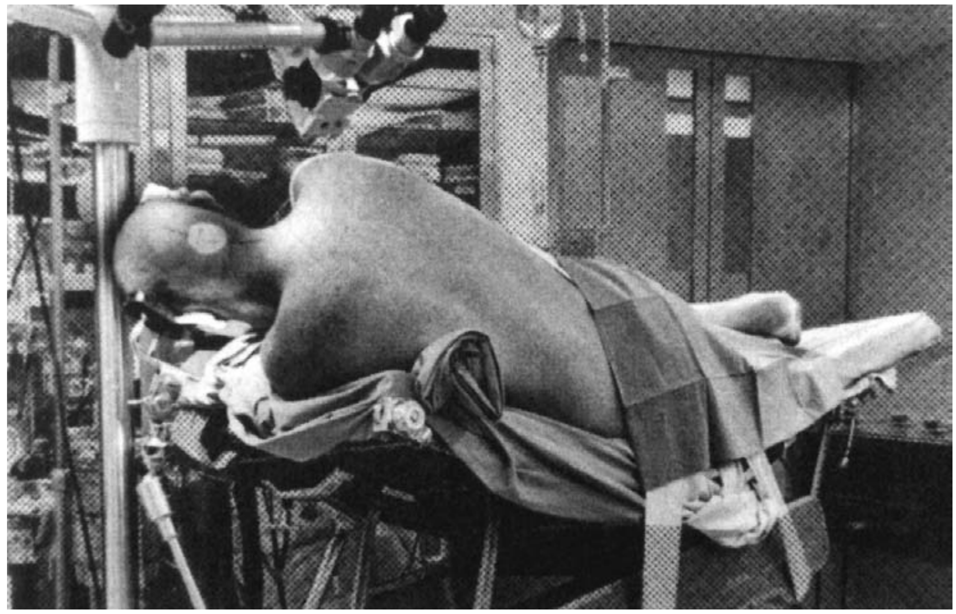


Fig. 1.**1** From J. Cruveilhier, *Anatomie pathologique du corps humain* (Paris: Baillière, 1829–35).



Figs. 1.**2a**, **b** Cushing, at the turn of the 20th century, was the first surgeon able to operate in the region with considerably reduced mortality. This was due to better exposure, careful control of bleeding, and intracapsular debulking of the tumor. These illustrations, from the collection of A. Earl Walker, show his method of exposing a cerebellopontine angle tumor.

Fig. 1.**3** The operating set-up, particularly the positioning of the patient on the operating table for the approach to the cerebellopontine angle, has always been a topic of debate. This picture shows a patient prepared for acoustic neurinoma surgery in the lateral position.



Figs. 1.**4 a**, **b** Although respectable results were achieved during the first half of the 20th century, none of the pioneers had the advantage of working with optical magnification. Littmann introduced the first operating microscope in 1953, which the Zeiss company manufactured under the trademark "OPMI-1." In 1954, William E. Hitselberger used a microscope during resection, after William House, his otologist, had also carried out exposure with the microscope. In Vienna, it was W. Koos who introduced the first microscope, and the original instrument is shown in the present picture. It was equipped with a monocular tube for the assistant surgeon, and also with a film camera to document the procedure.

Fig. 1.**5** Minimally invasive microsurgical techniques have altered the current goals in the treatment of acoustic neurinomas. This illustration shows the situation in a contemporary operating theater. Both anatomic and functional preservation of the cranial nerves, especially the eighth nerve, has become routine in experienced hands. Nowadays, several minimally invasive techniques have become established in order to achieve better outcomes. A clear intraoperative strategy based on an individually tailored surgical plan should lead to an optimal surgical intervention.

2 Microanatomy of the Cerebellopontine Angle

- Introduction
- General Anatomy
- Special Clinical Anatomy and Topography of the Facial and Vestibulocochlear Nerves in Large Acoustic Neurinomas

Introduction

The feasibility and safety of any microsurgical intervention depend on the surgeon's familiarity with the neuroanatomy. The appropriate neuroanatomical preparations are therefore included here and presented in relation to the special topographic region. Special attention has been given to the microscopic anatomy. Each actual anatomical specimen is accompanied by a schematic drawing identifying the various structures that are most important. The different specimens have been chosen on the basis of their relevance to the topic of this atlas and the pathology. For identification, the arteries have mostly been injected with red latex and the veins with blue latex. By reviewing the anatomical specimens, the reader can better appreciate the neuroanatomical limits of the surgical intervention as well as the options for enlarging the surgical exposure.

This chapter is subdivided into two parts. The first part starts with a general overview of the cerebellopontine region. The anatomy is presented from various visual angles to offer the reader more detail and provide a better grasp of the three-dimensional situation. The neural structures and bone structures are presented using different cross-sections through the petrous bone.

The second part, on the special clinical anatomy, focuses on the different topographical relationships of the seventh and eighth nerves in large acoustic neurinomas. This is not a typical anatomical presentation, but rather a clinical one. It starts with the seventh nerve, followed by the eighth nerve, showing the different possible relationships between the anatomical structures and the pathology using real intraoperative situations. To allow the reader to follow the course in three-dimensional space, the intraoperative photographs have been modified using a computer. The courses of the seventh and eighth nerves are marked in orange and green.

General Anatomy

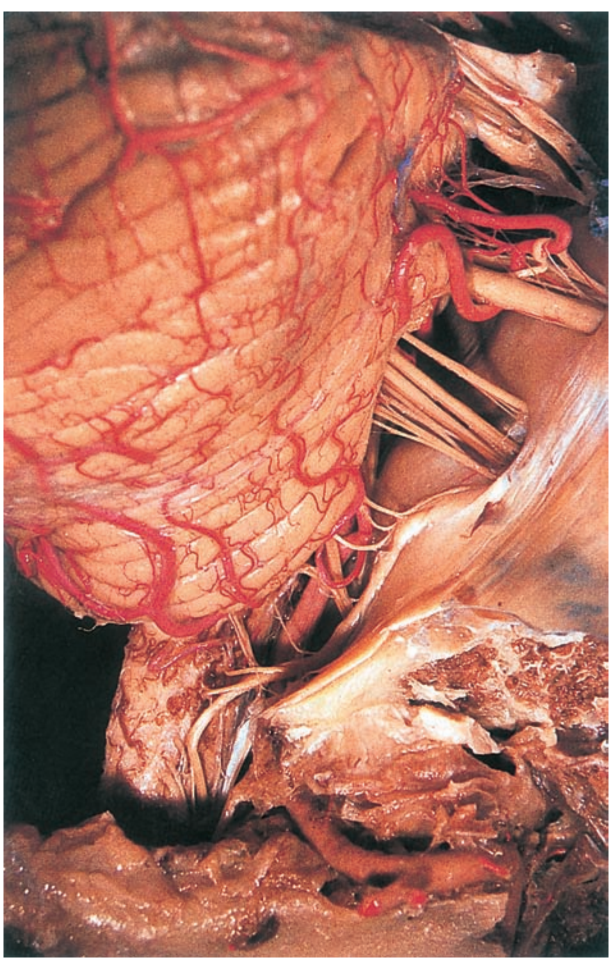
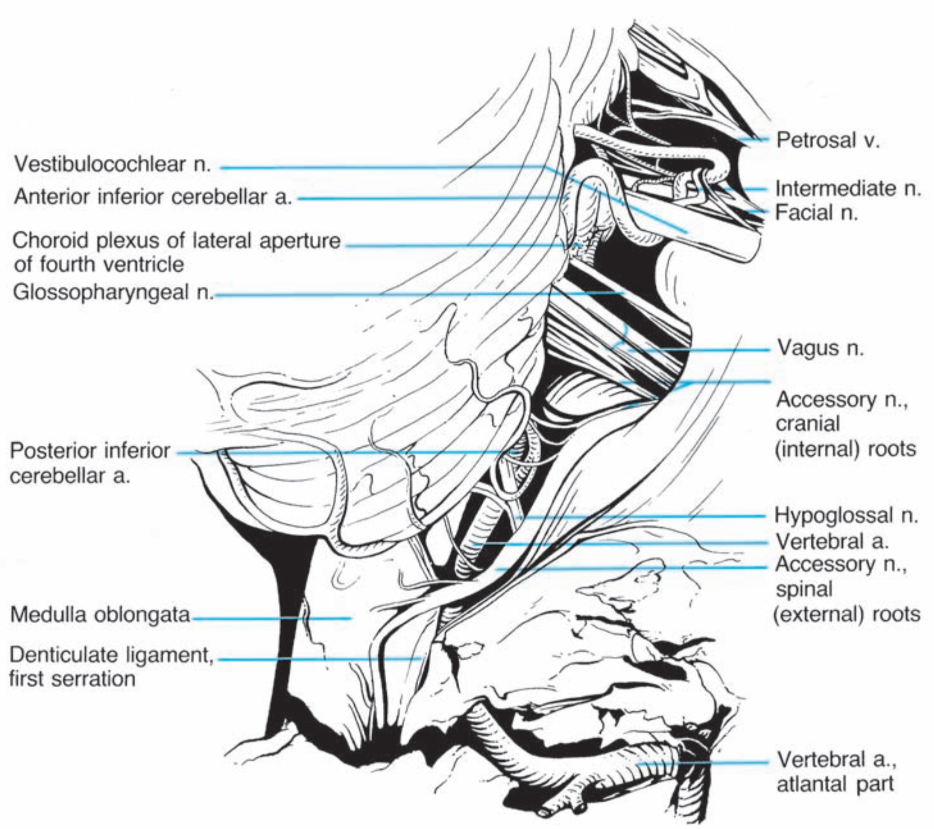


Fig. 2.**1** The right cerebellopontine angle, with exposure of the nerves and arteries. The tentorium has been reflected forward, and the cerebellum has been elevated (viewed from the side and behind).



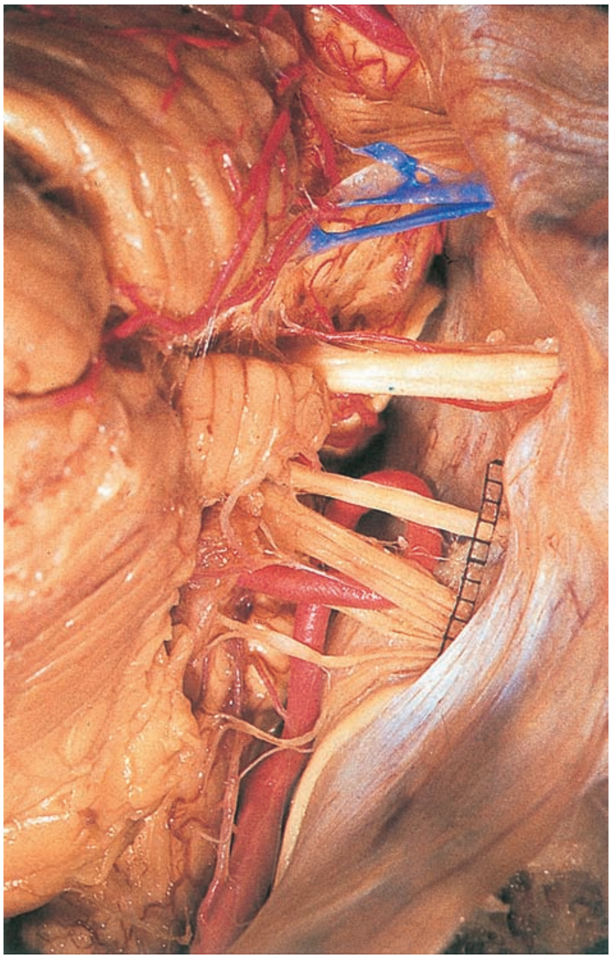
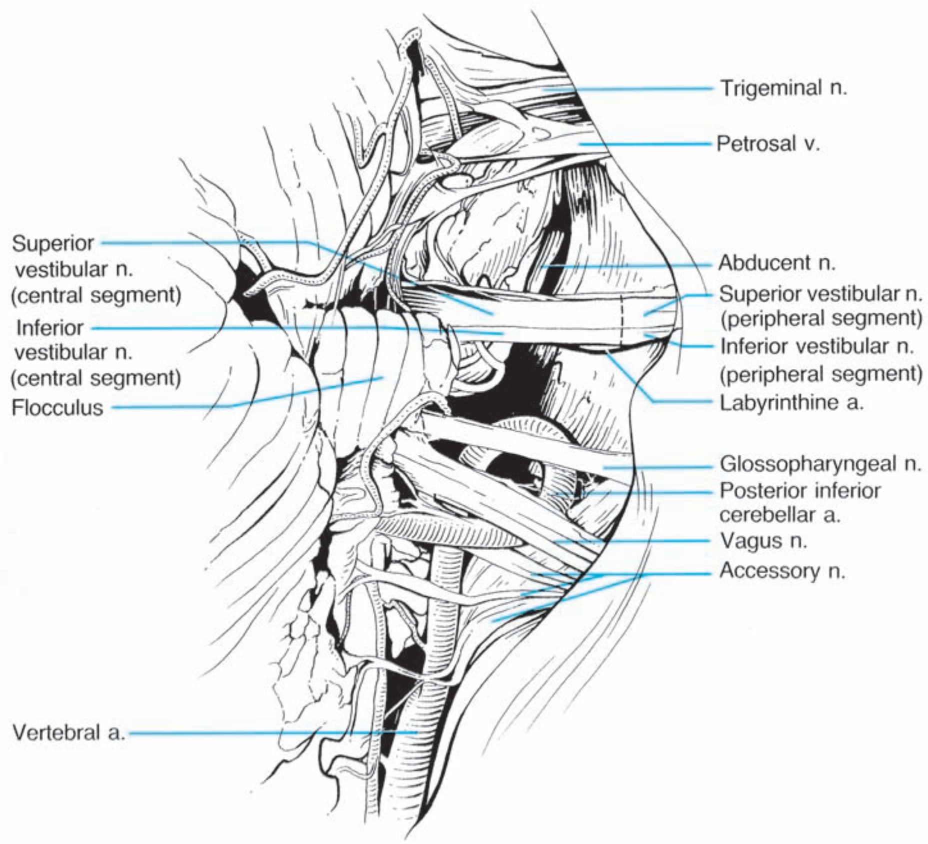


Fig. 2.**2** The right cerebellopontine angle, viewed from the lateral aspect.



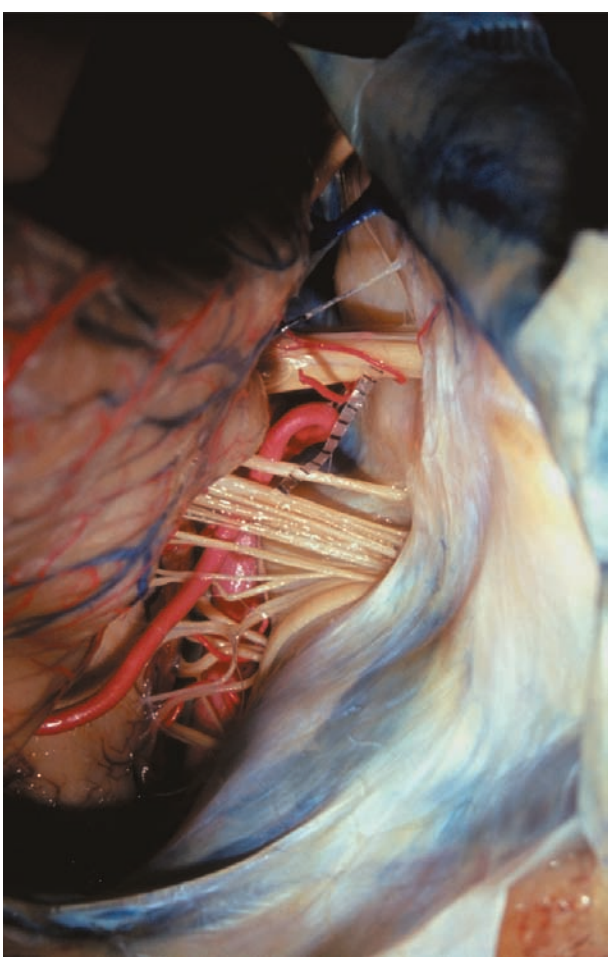


Fig. 2.**3** Posterior inferior cerebellar artery, seen from the dorsolateral aspect.

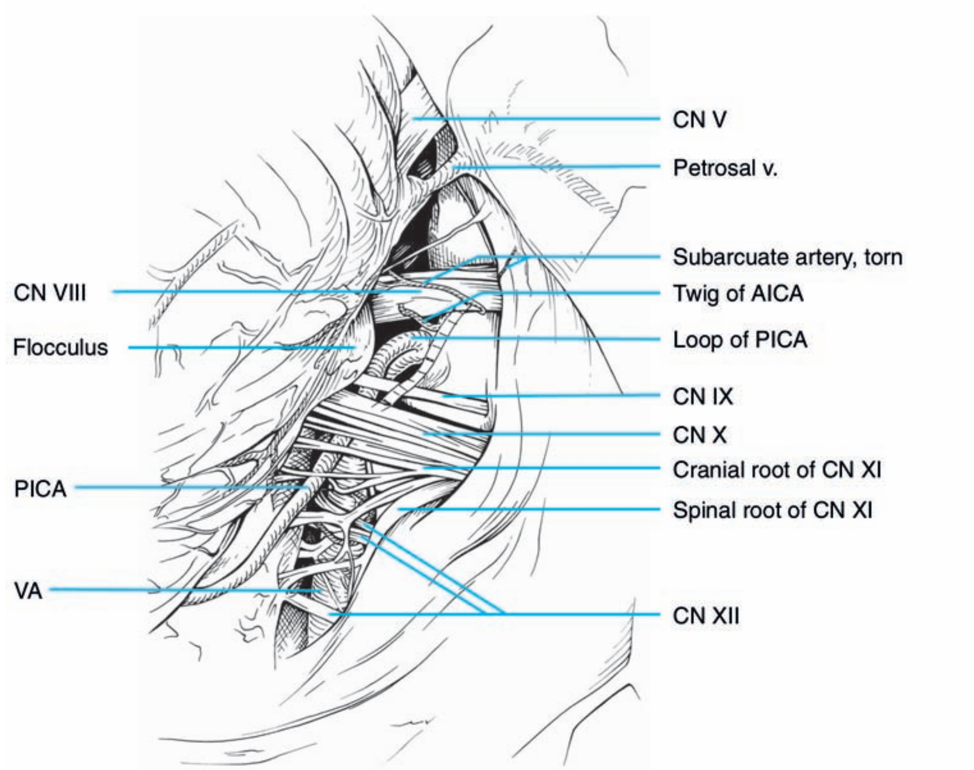
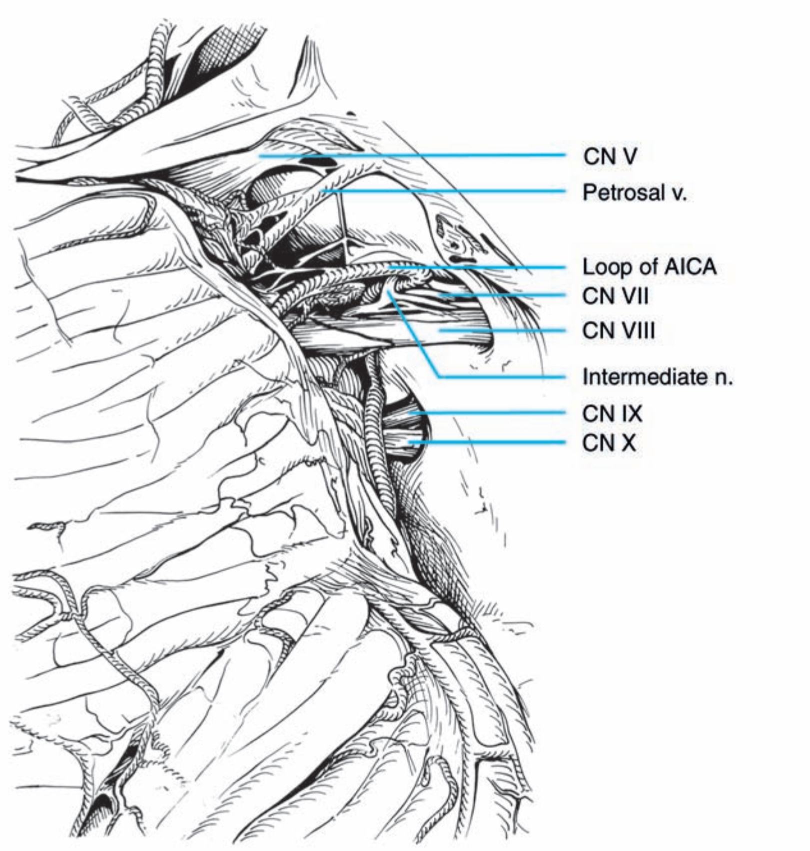


Fig. 2.4 The intermediate nerve has been displaced upwards by a loop of the anterior inferior cerebellar artery (a rare variation).



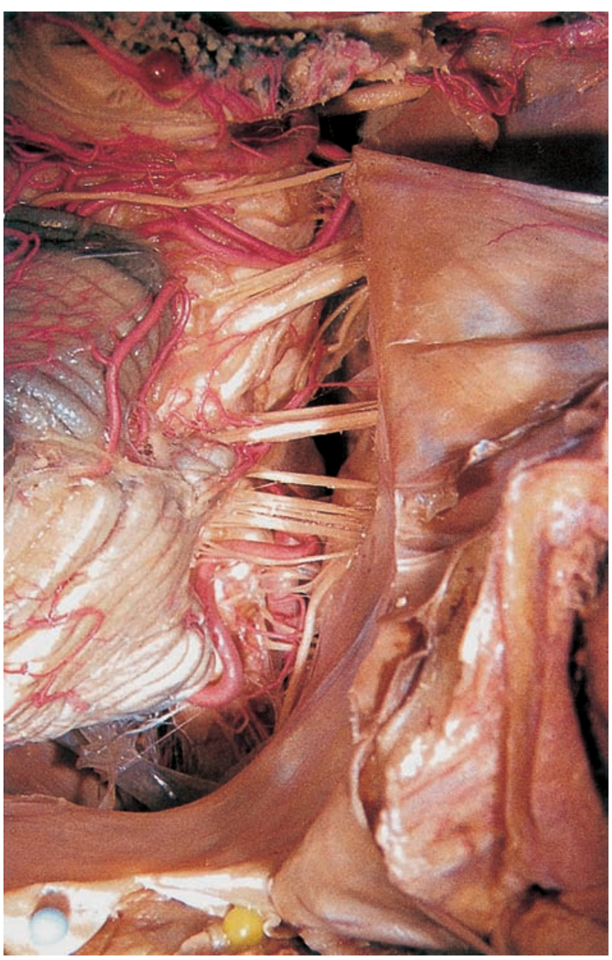
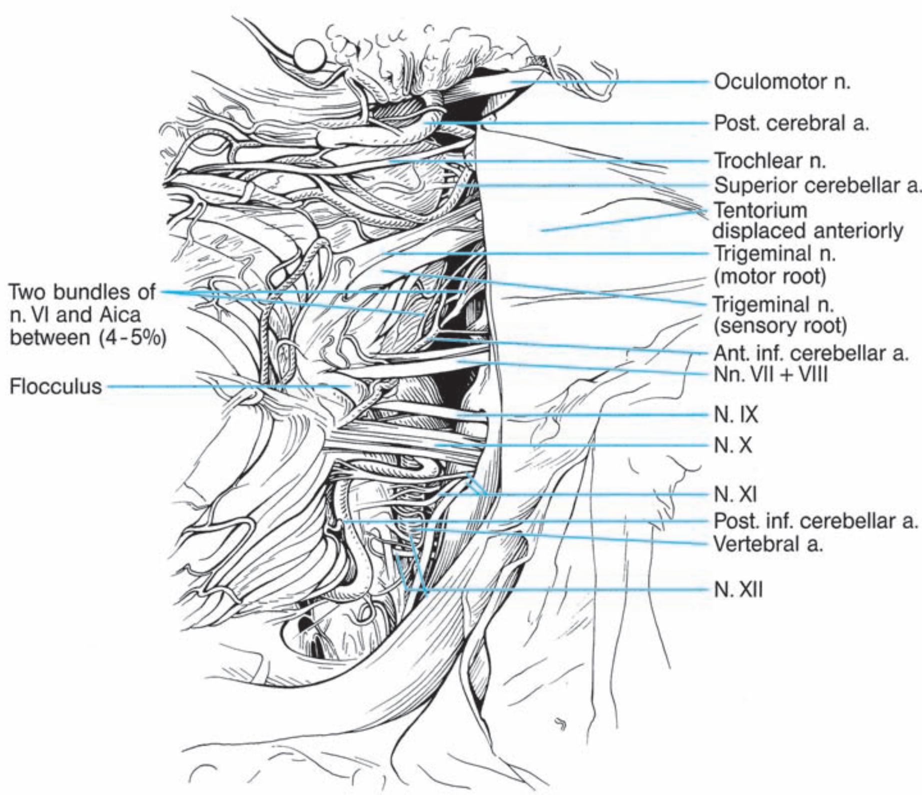


Fig. 2.5 Posterior cranial fossa. The tentorium is reflected forward, and the cerebellum is elevated dorsally. The course of the cranial nerves in the posterior fossa en route to the clivus is shown, including the junction between the middle and posterior fossa. Seen from behind, laterally, and above.



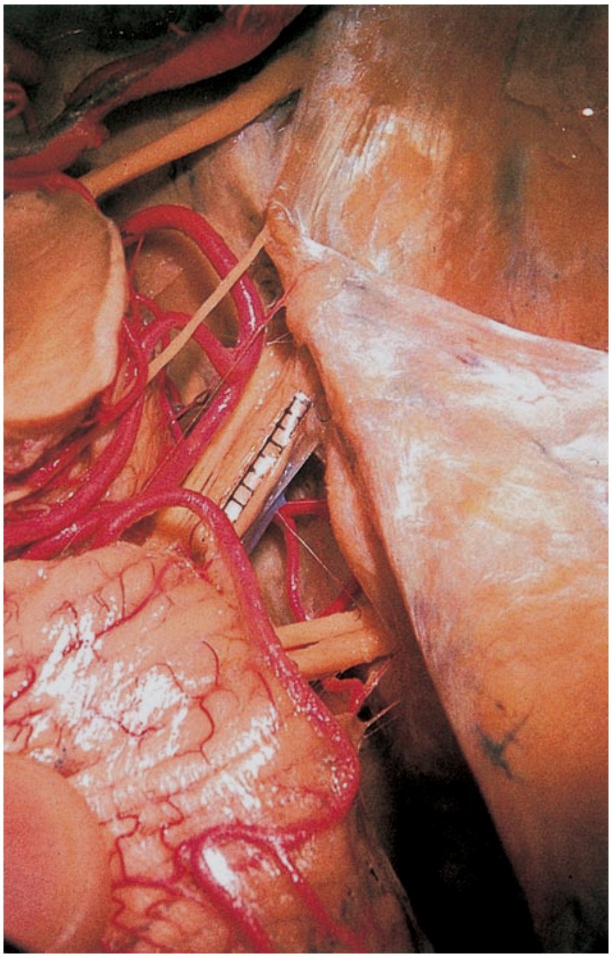
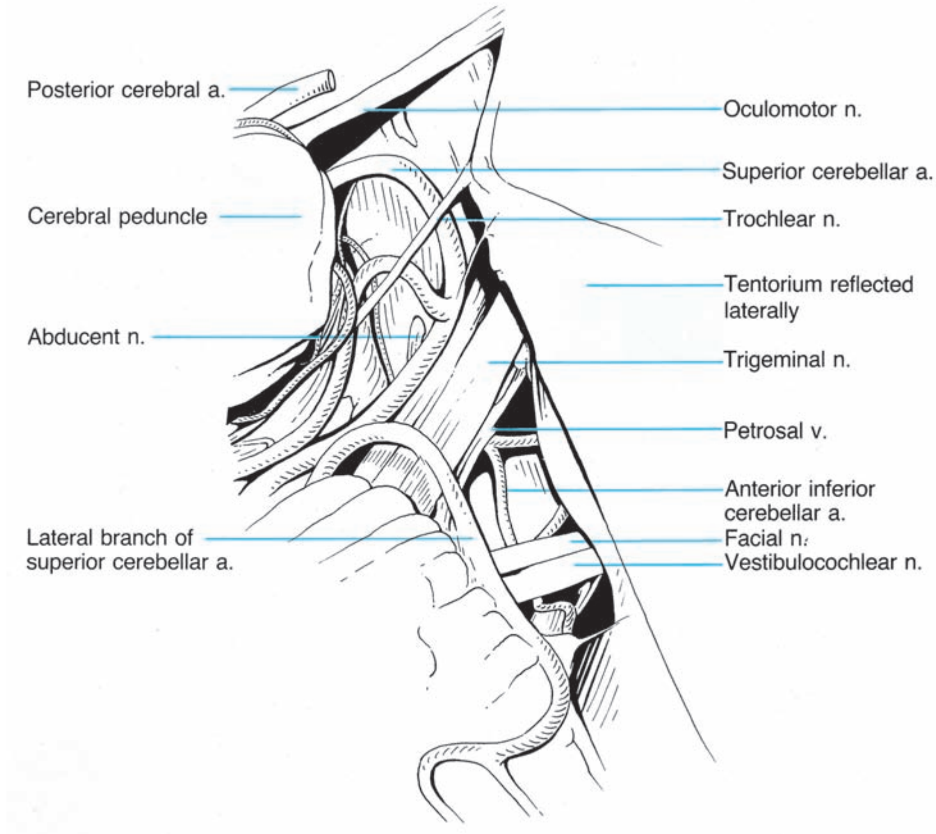


Fig. 2.**6** View of the cerebellopontine angle from above. The tentorium is reflected from the side of the ambient cistern. Notice the acoustic, trigeminal, and trochlear nerves.



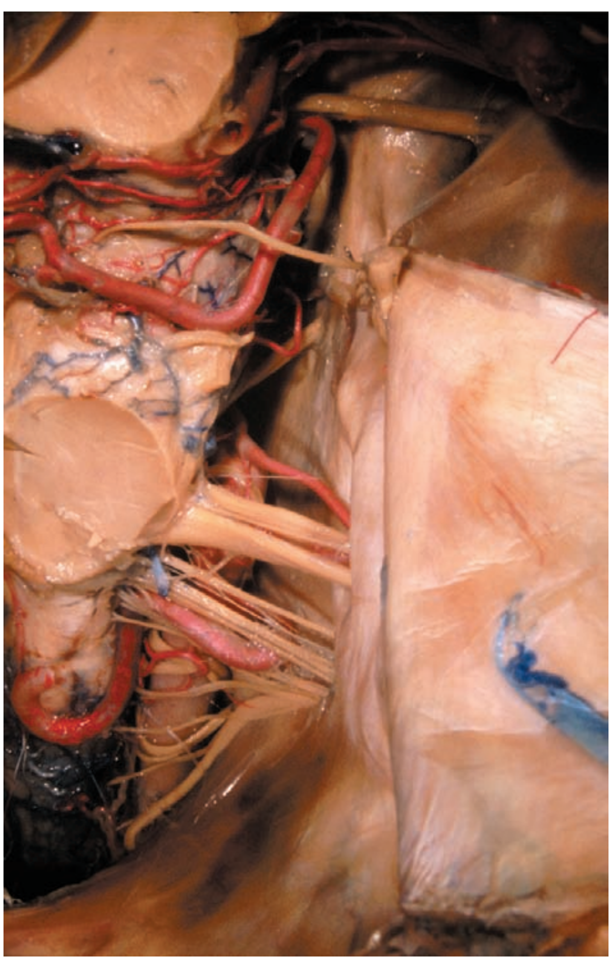
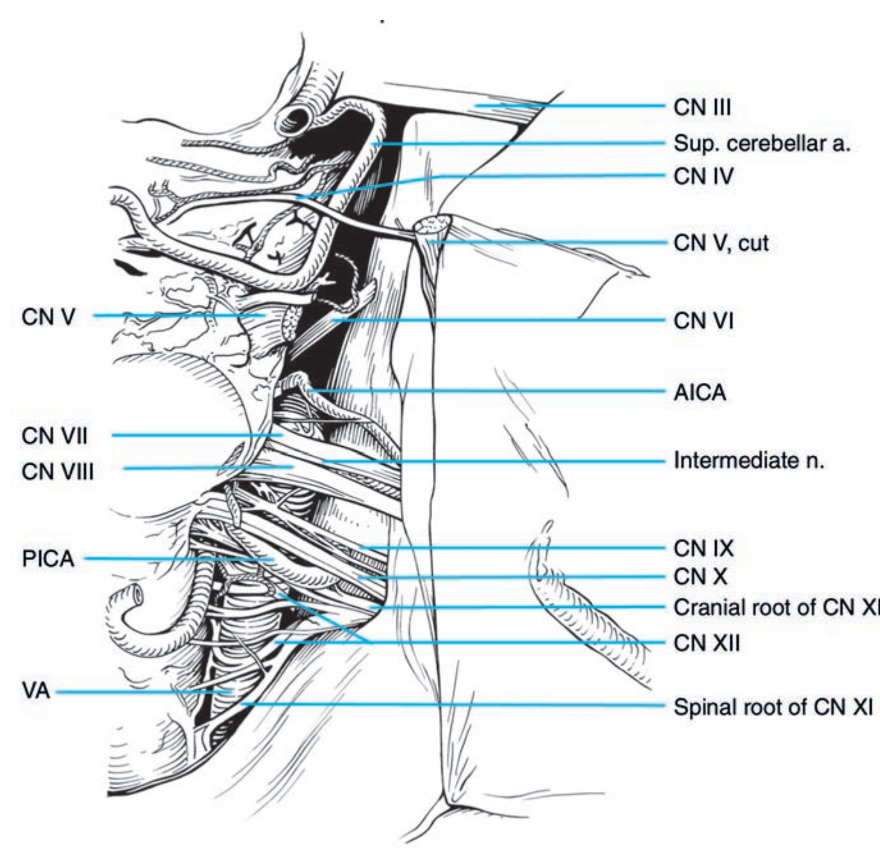


Fig. 2.**7** Nerves and vessels in the posterior cranial fossa (cerebellum sectioned), seen from the lateral aspect.



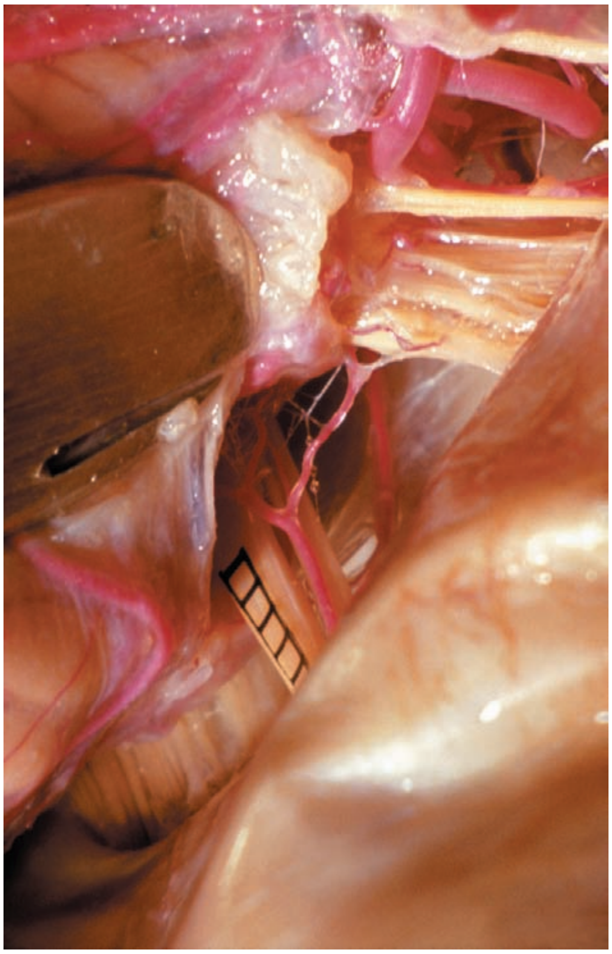
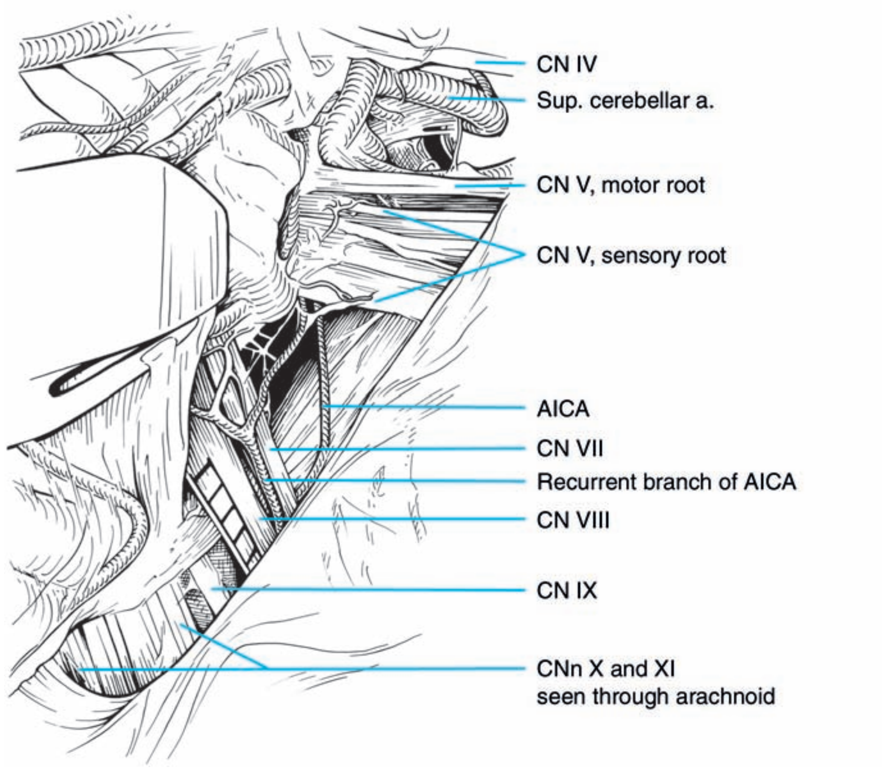


Fig. 2.**8** Cranial nerves IV–XI after a transtentorial approach, seen from above.



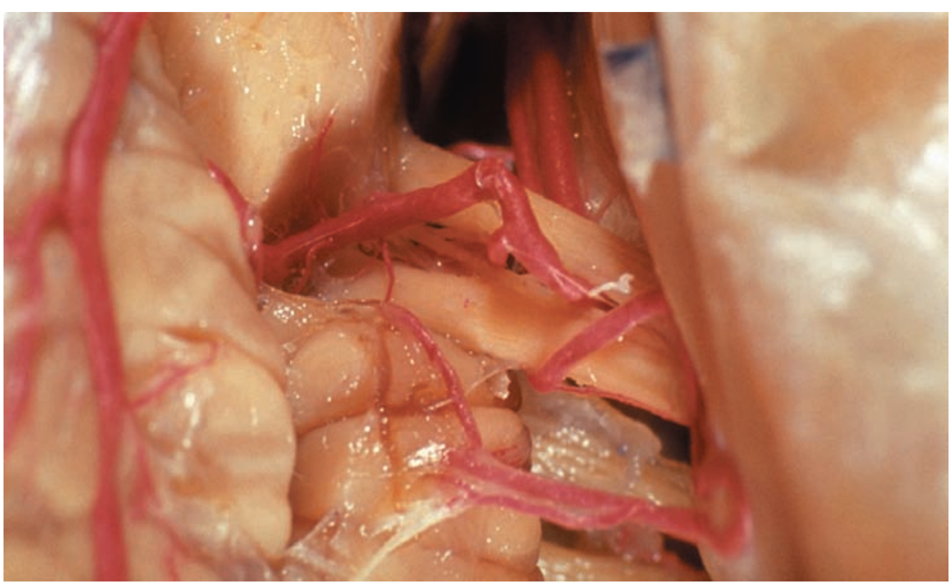
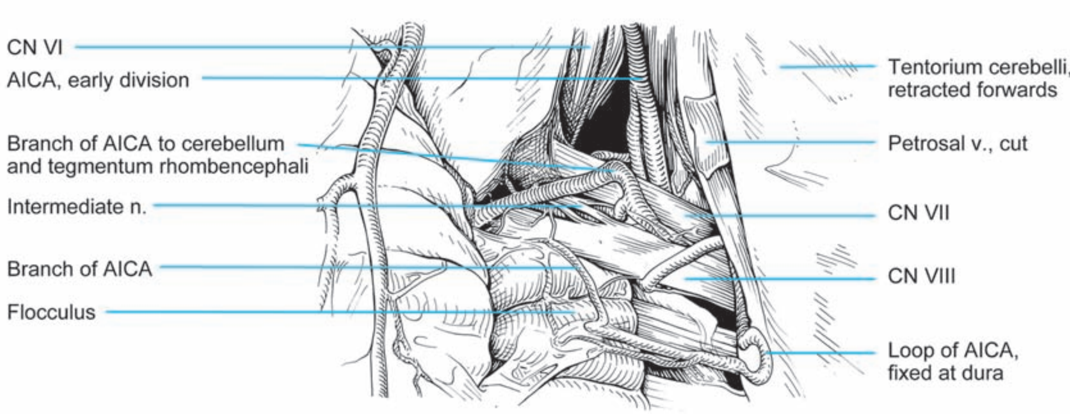


Fig. 2.**9** The vestibulocochlear and facial nerves from above, with the anterior inferior cerebellar artery fixed.



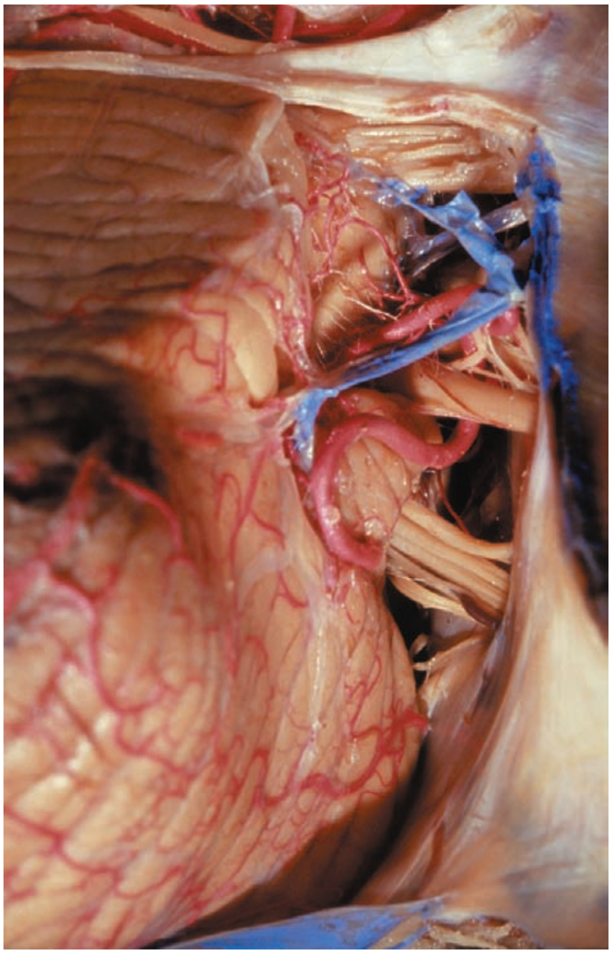
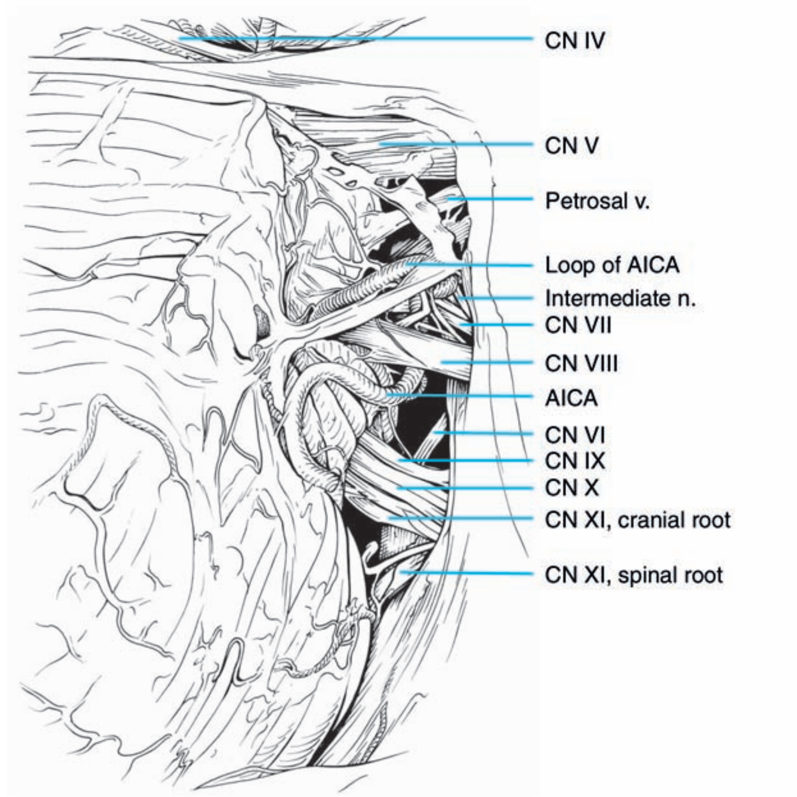


Fig. 2.**10** The intermediate nerve displaced upwards by a loop of the anterior inferior cerebellar artery (a rare variation).



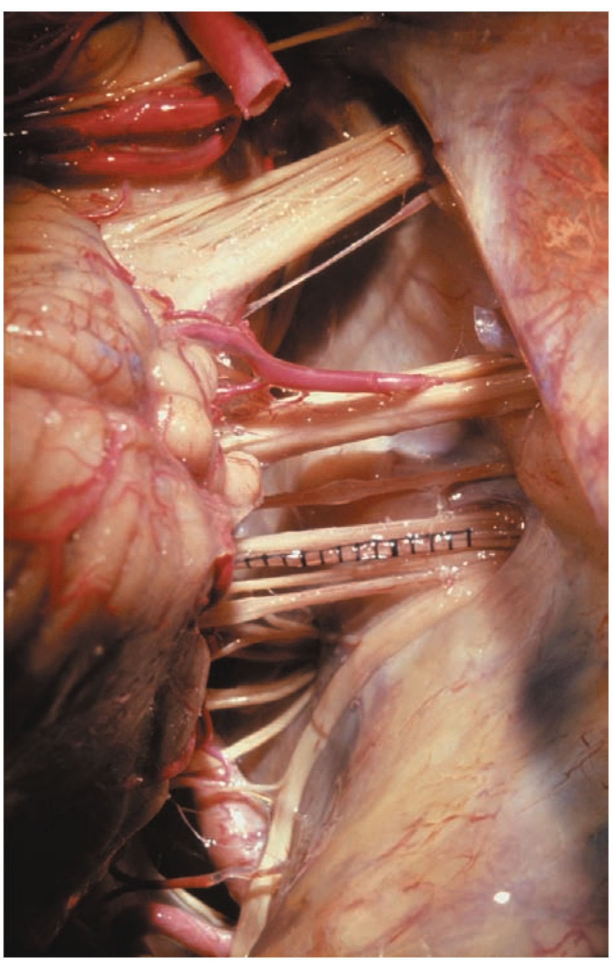


Fig. 2.**11** The right cerebellopontine angle, seen from above, with the anterior inferior cerebellar artery between cranial nerves VII and VIII.

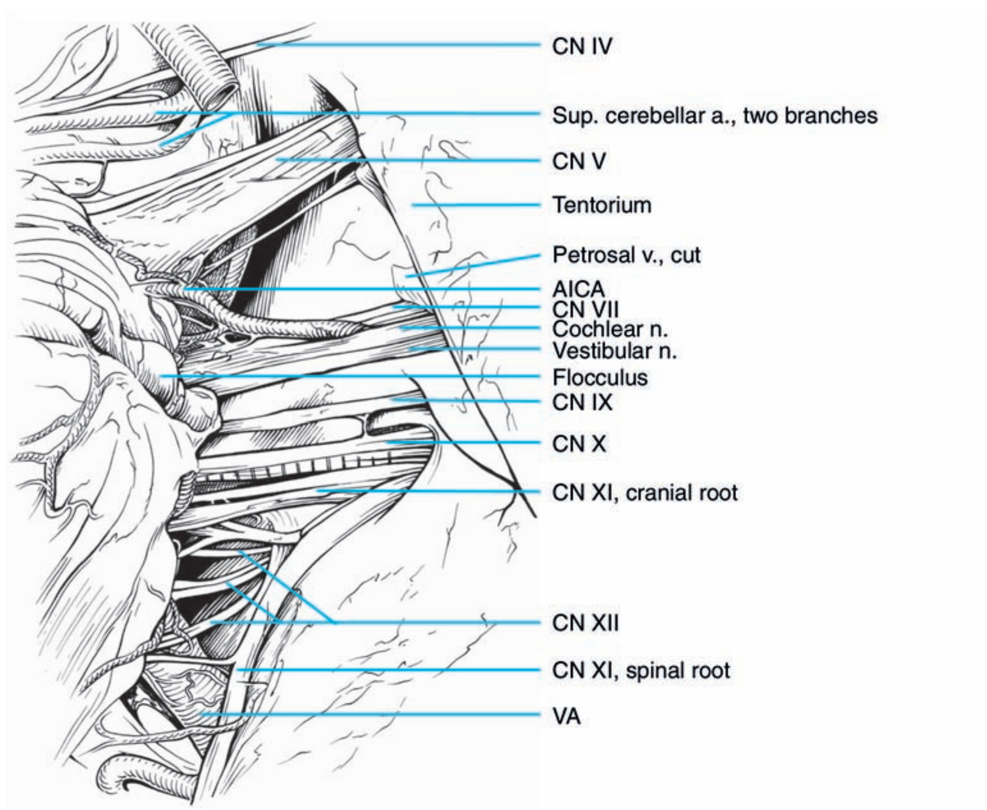
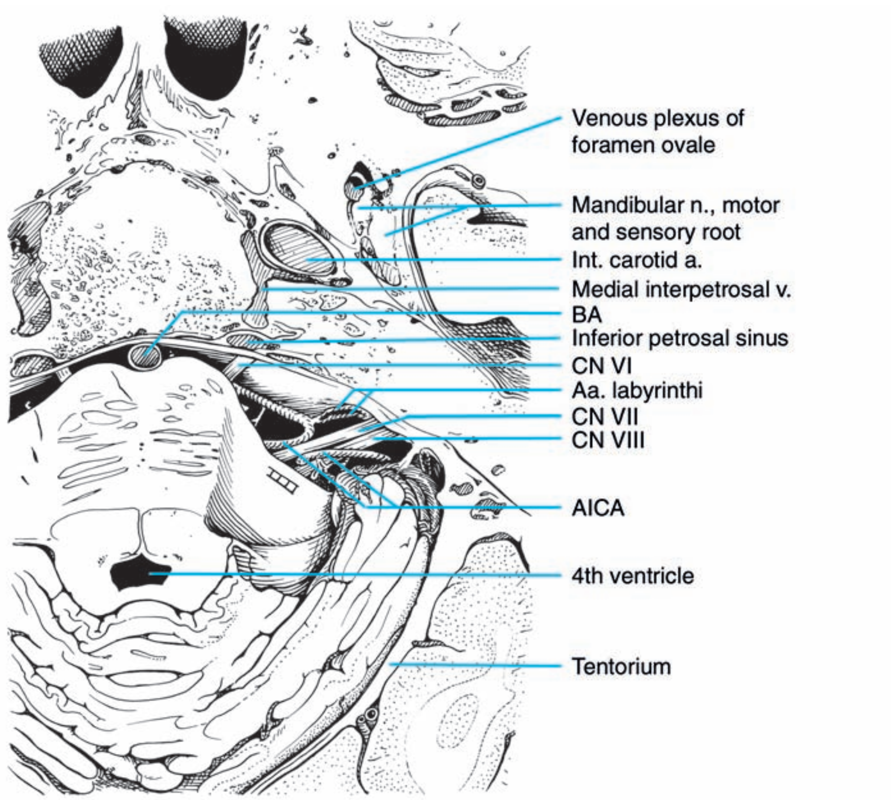


Fig. 2.**12** The labyrinthine arteries, seen from above.



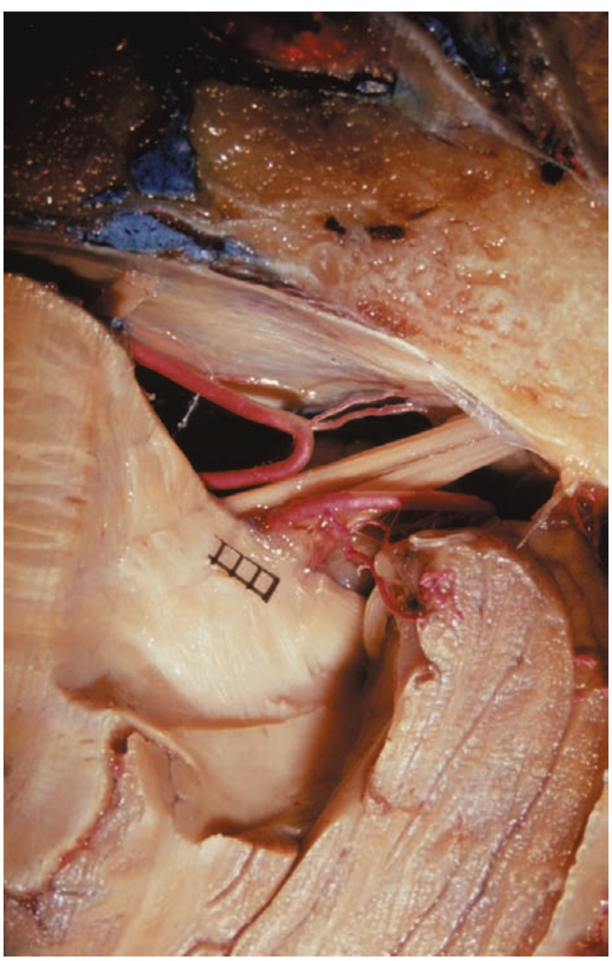
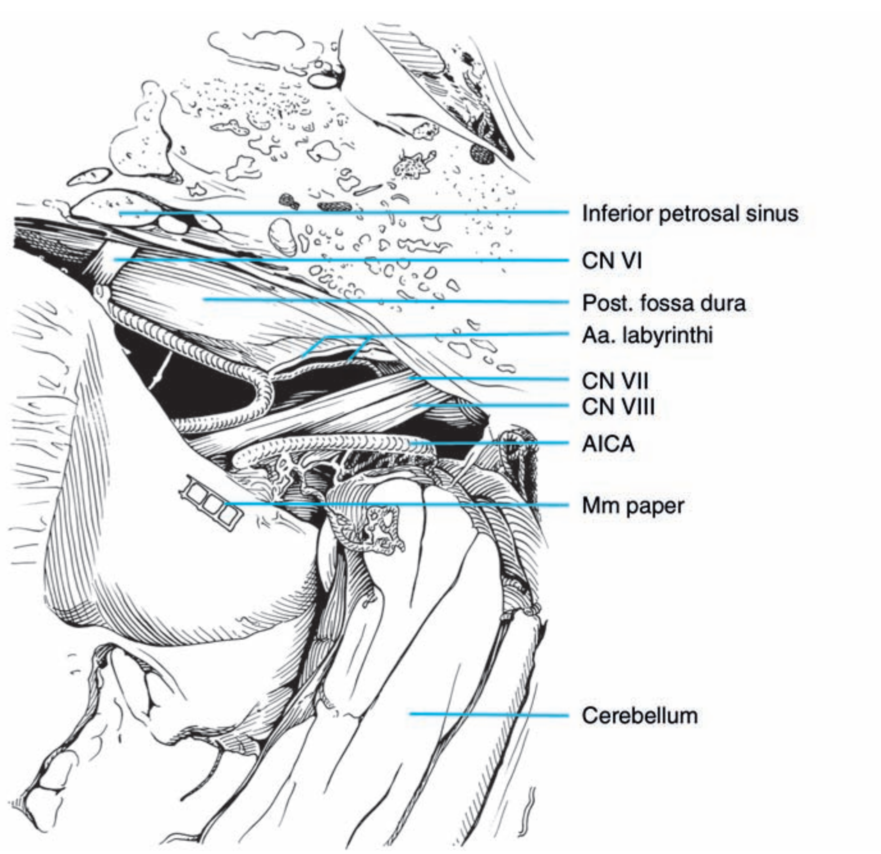


Fig. 2.**13** The labyrinthine arteries, seen from above.



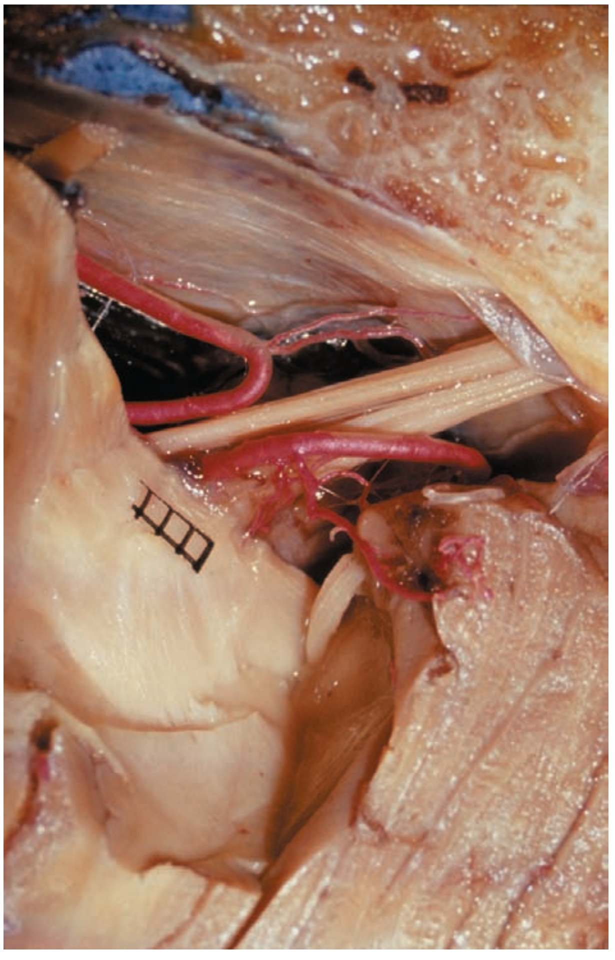
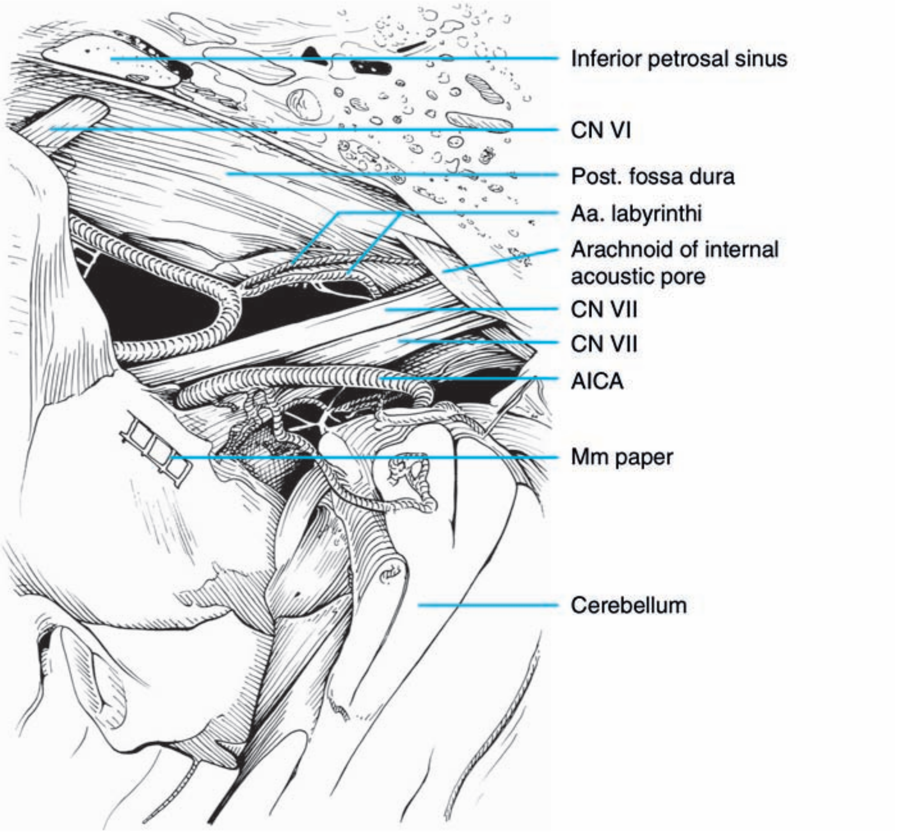


Fig. 2.**14** The labyrinthine arteries, seen from above, with the anterior inferior cerebellar artery (AICA) coursing between cranial nerves VII and VIII at the entry zone.



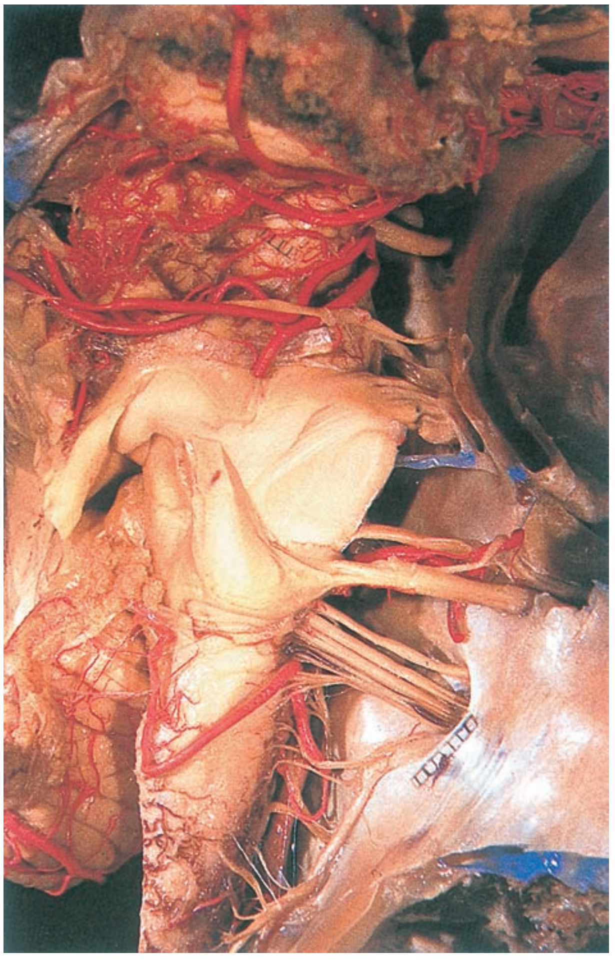
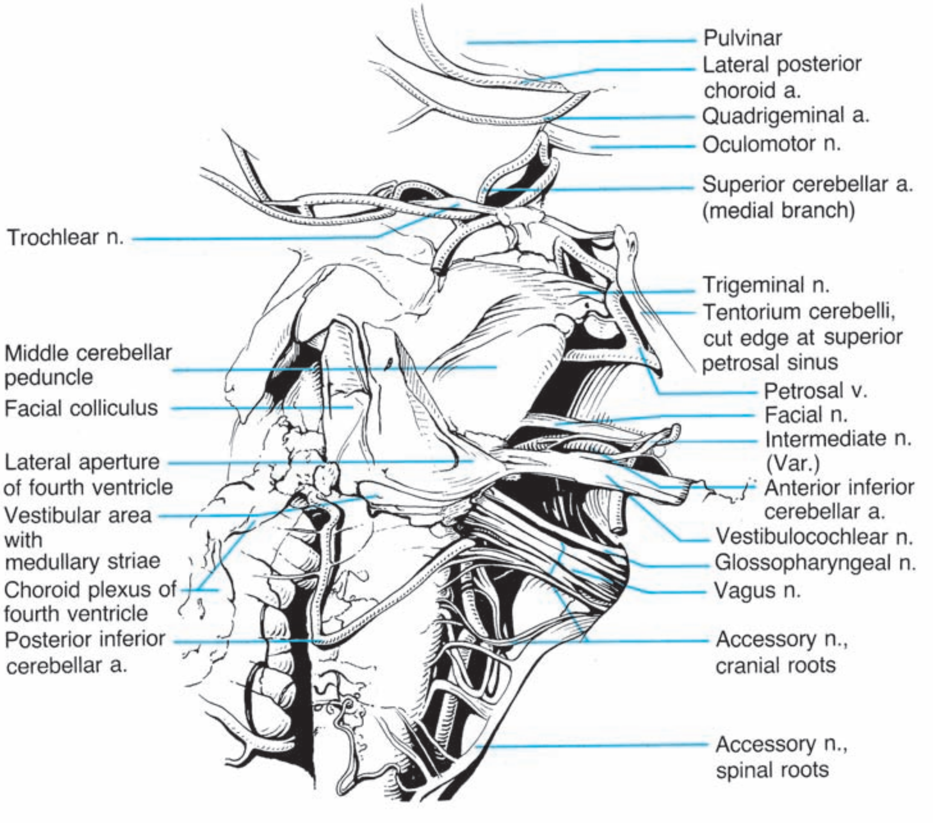


Fig. 2.**15** The right cerebellopontine angle, after removal of the cerebellum by dividing the cerebellar peduncle. Seen from the lateral aspect.



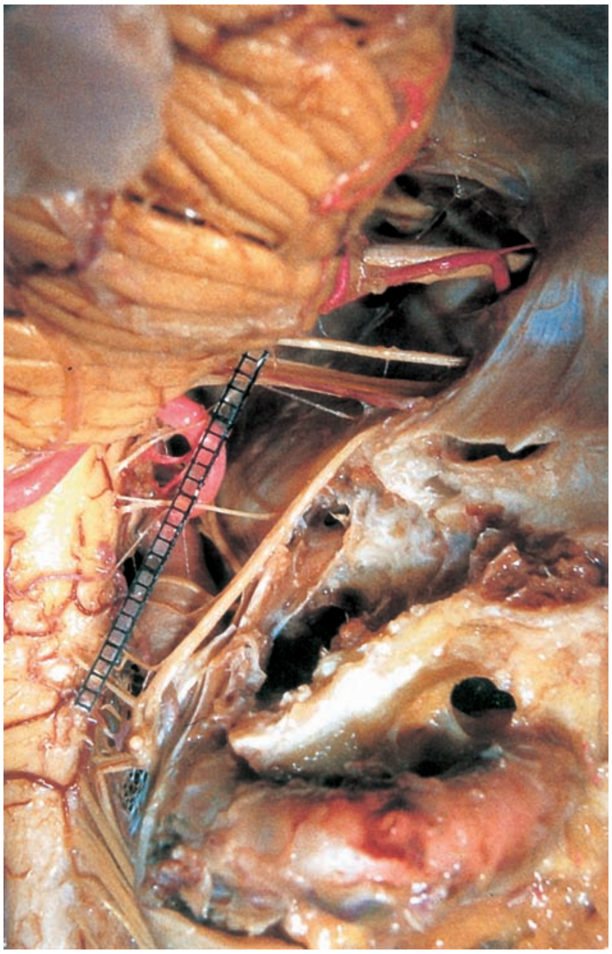
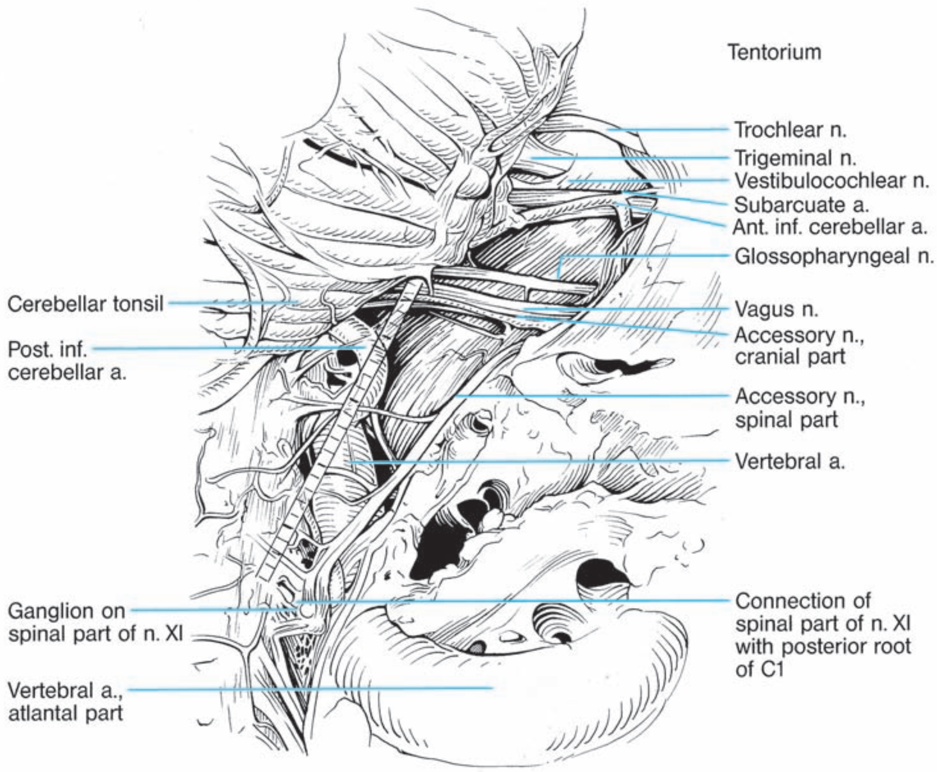


Fig. 2.**16** The cerebellopontine angle and the craniocervical junction (from behind and below, right side).



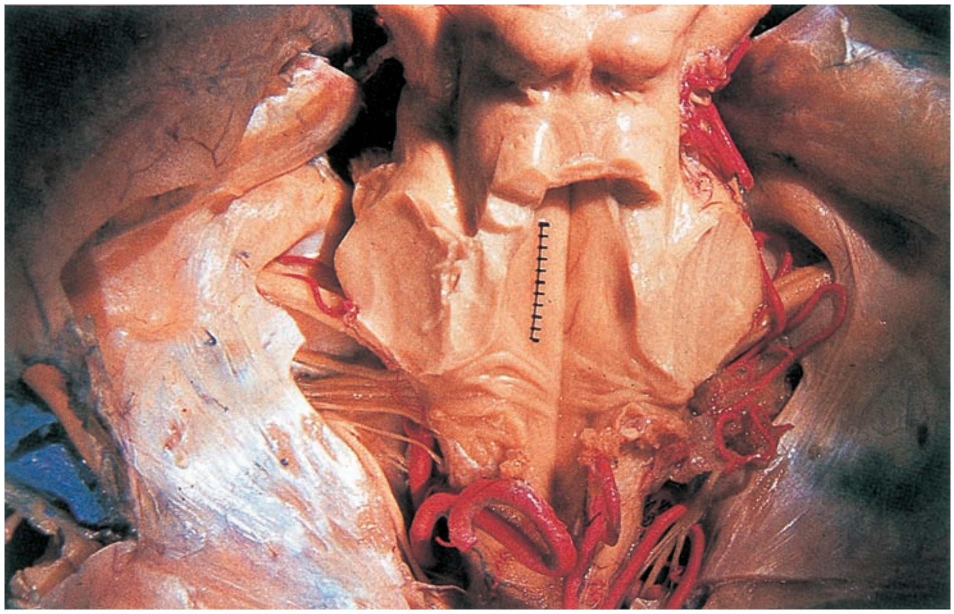
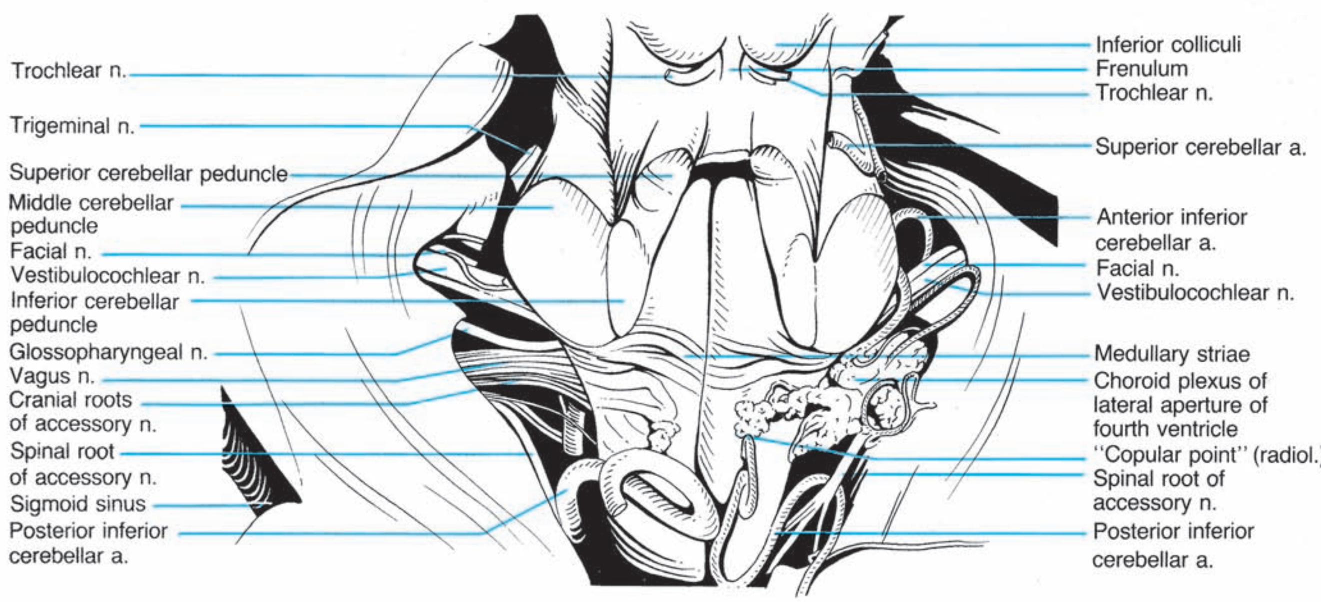


Fig. 2.**17** The brain stem and fourth ventricle from above, with the cerebellum resected.



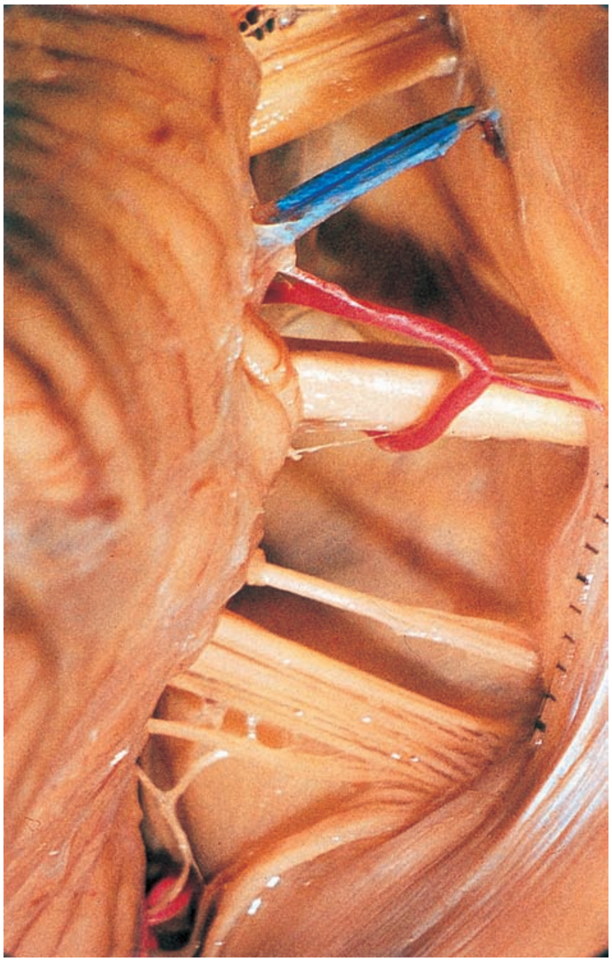
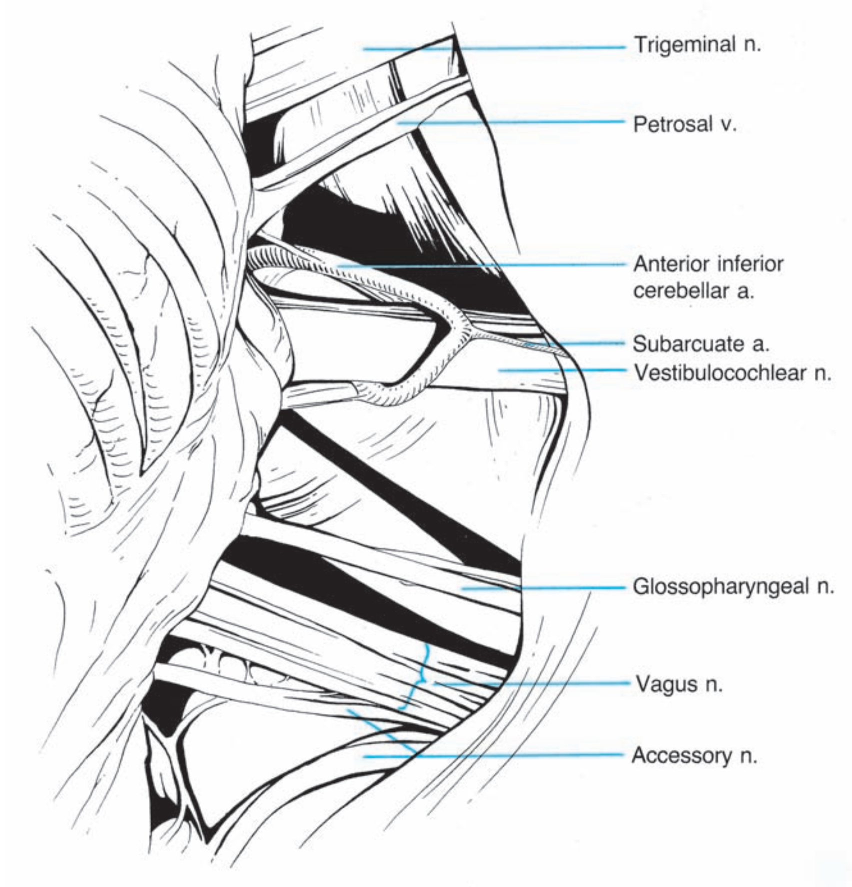


Fig. 2.**18** Higher magnification of the course of the cranial nerves within the cerebellopontine angle. Notice also the petrosal vein and the subarcuate artery.



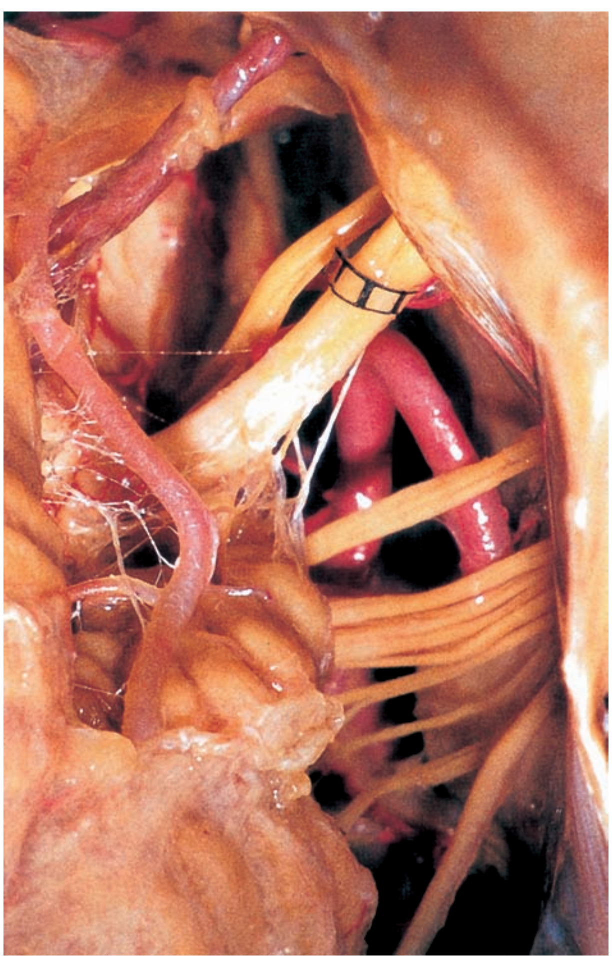
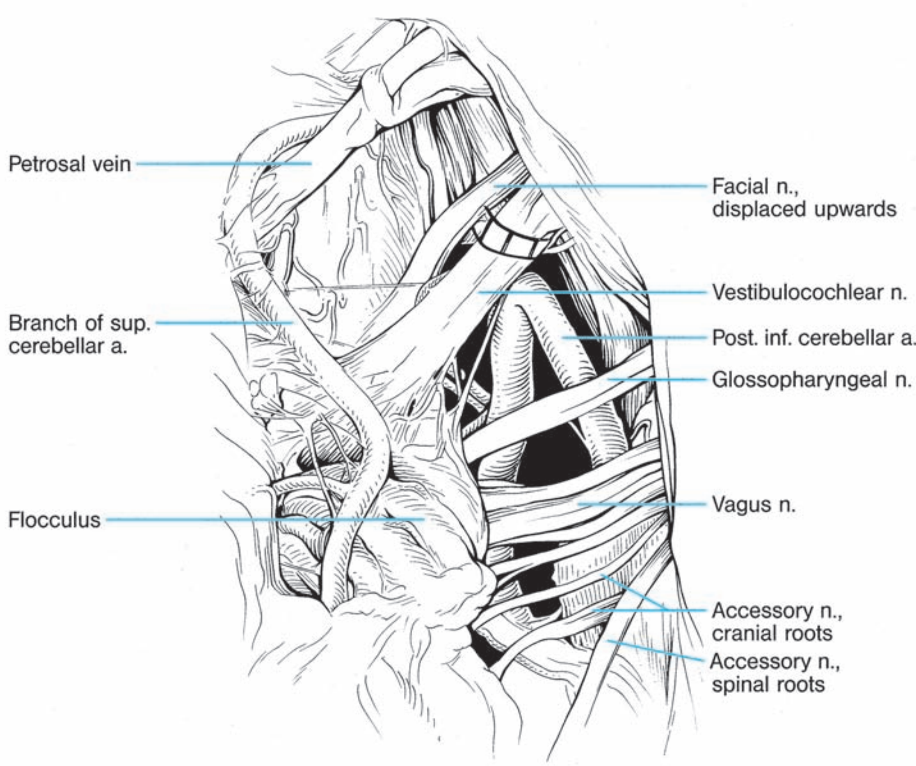


Fig. 2.**19** An anatomical specimen of the cerebellopontine angle, indicating the cranial extent of the loop of the posterior inferior cerebellar artery.



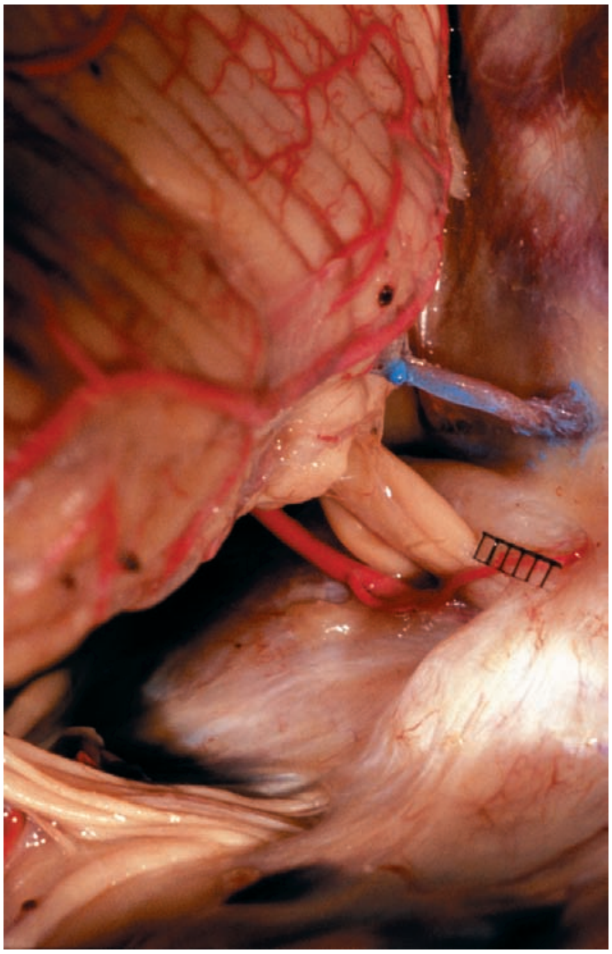
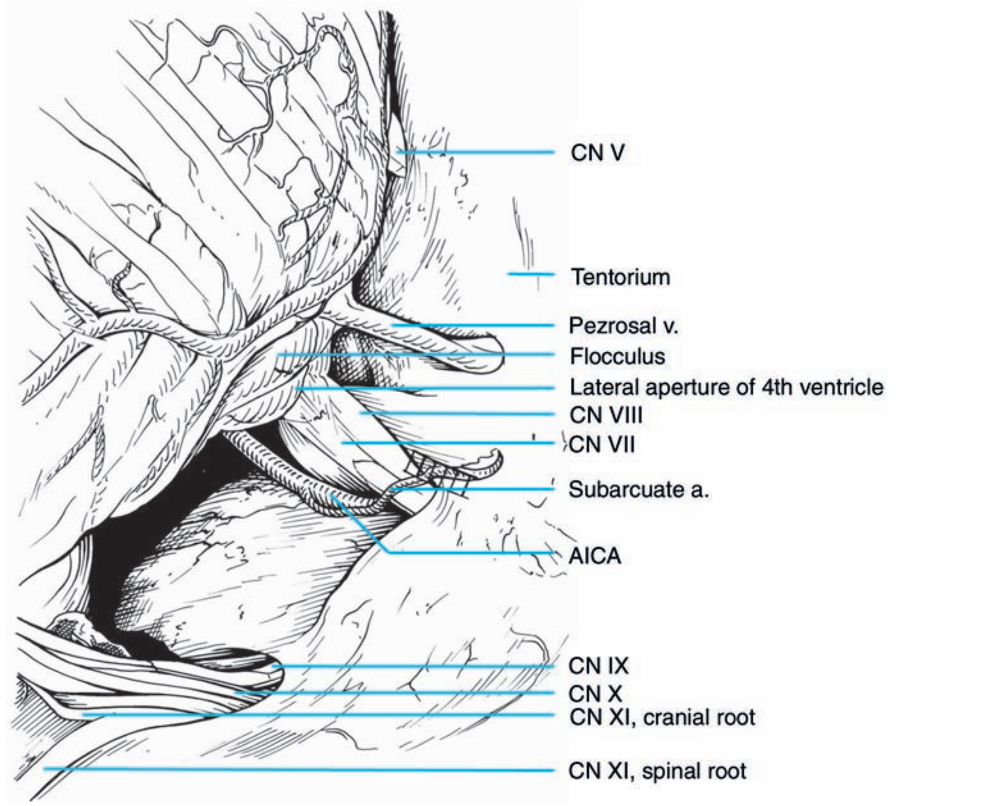


Fig. 2.**20** The subarcuate artery, seen from behind and below.



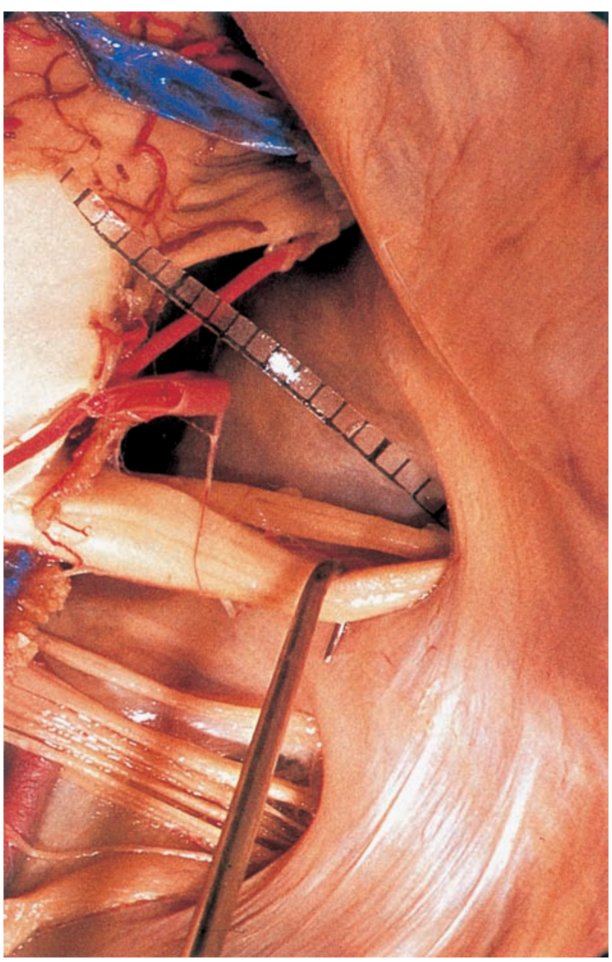
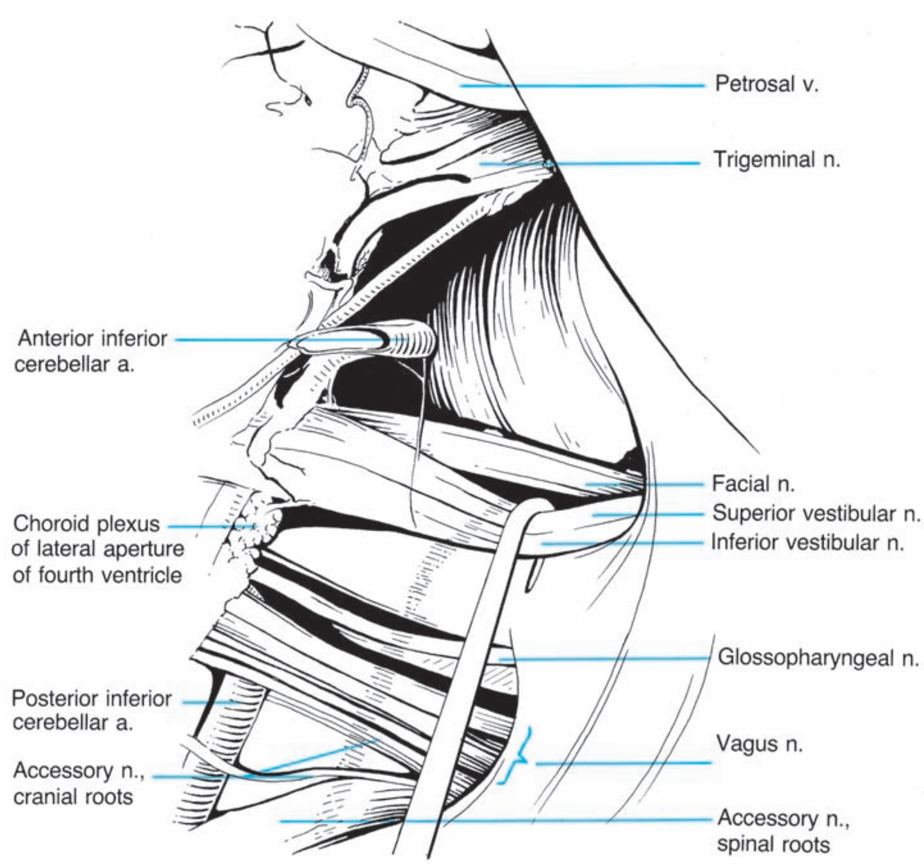


Fig. 2.**21** A lateral exposure of the right cerebellopontine angle. The eighth nerve has been retracted with a nerve hook, exposing the underlying seventh nerve.



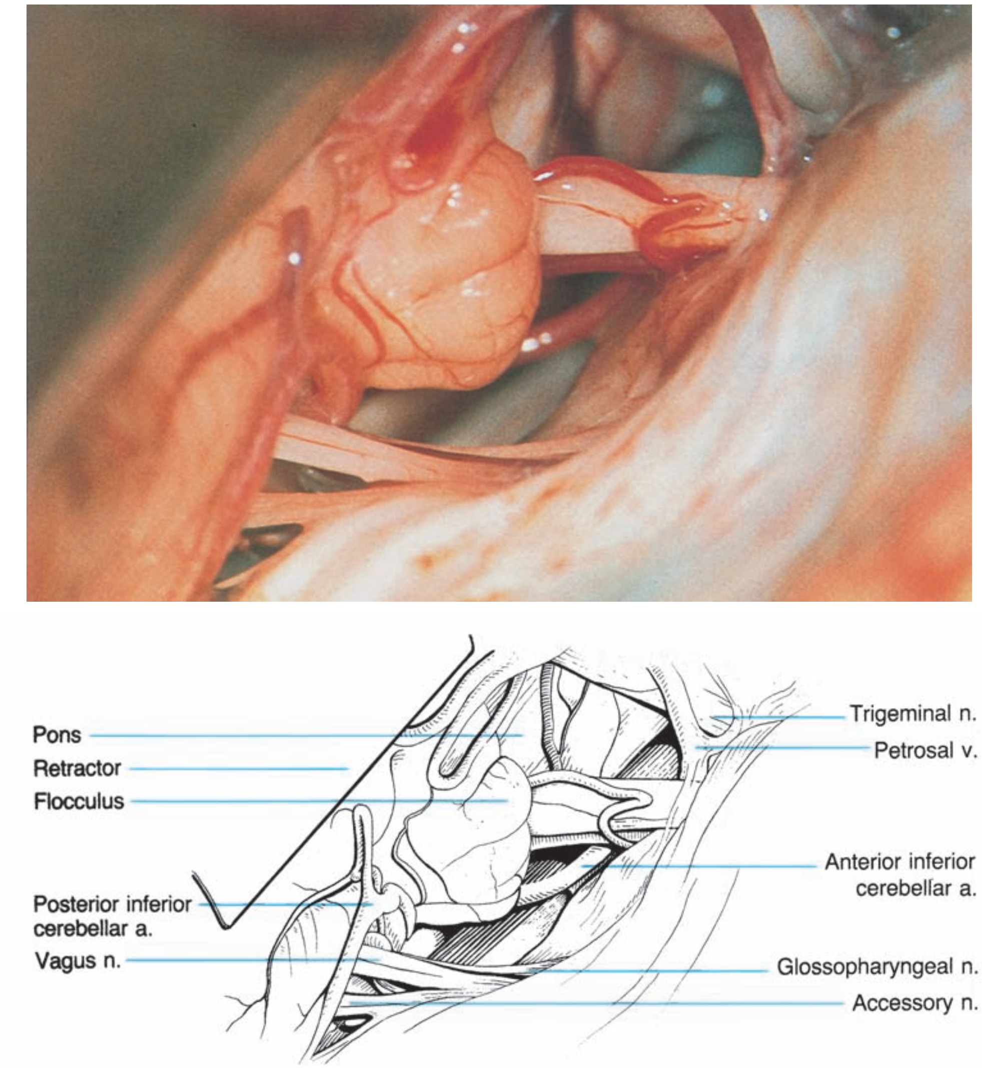


Fig. 2.**22** The surgeon's view of the cerebellopontine angle. There is a prominent flocculus overlying the origin of the seventh and eighth nerves on the brain stem.

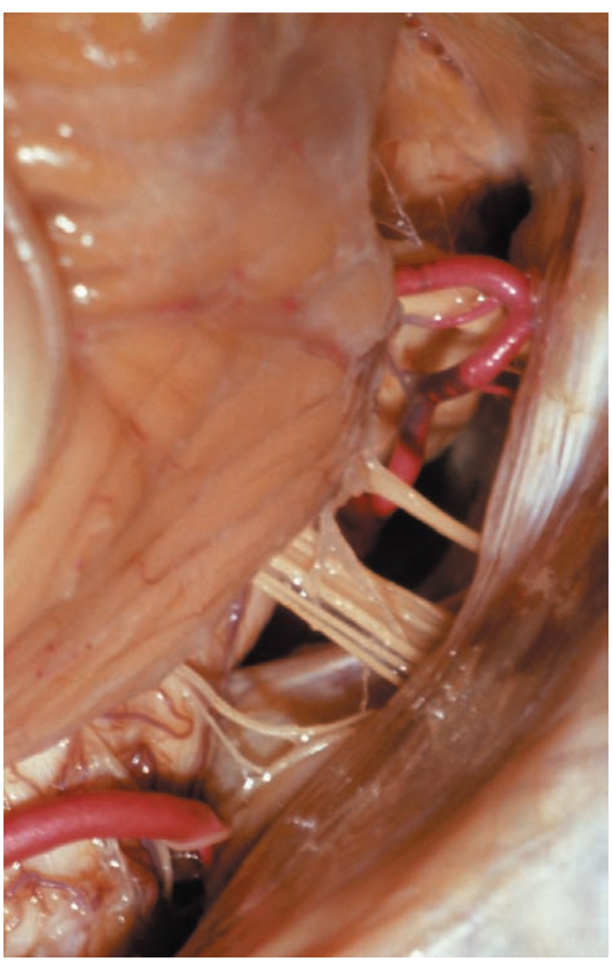
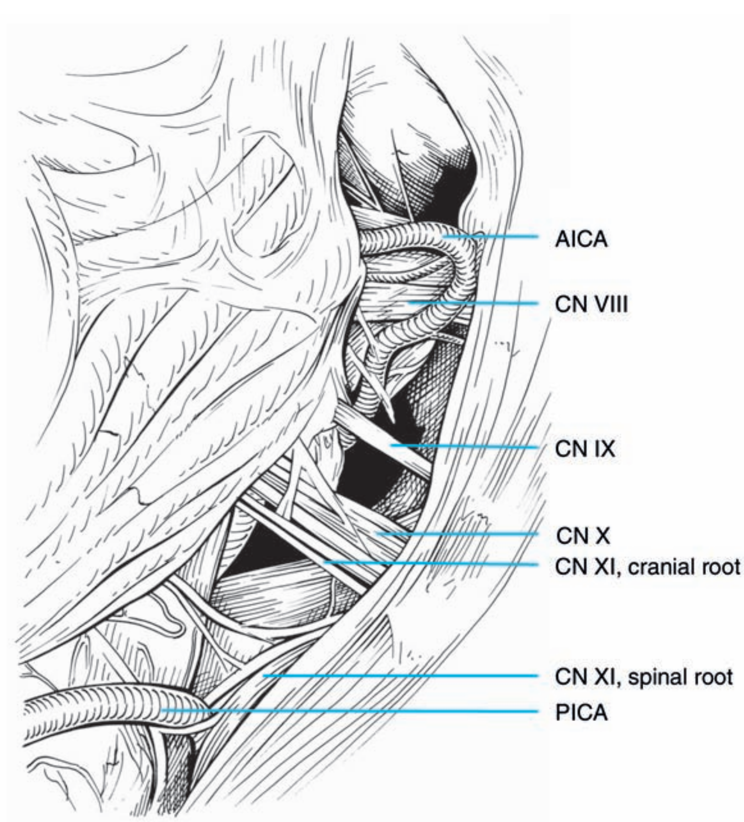


Fig. 2.**23** The cerebellopontine angle, seen from the lateral aspect.



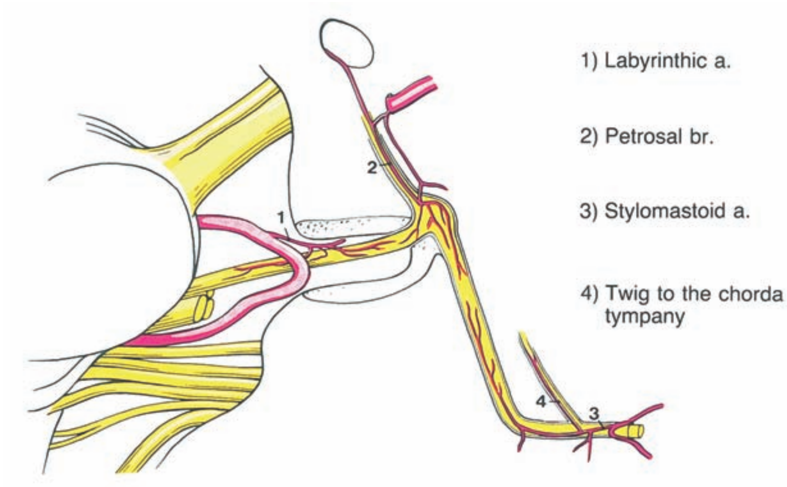


Fig. 2.**24** The various vessels that supply the facial nerve over its entire course.

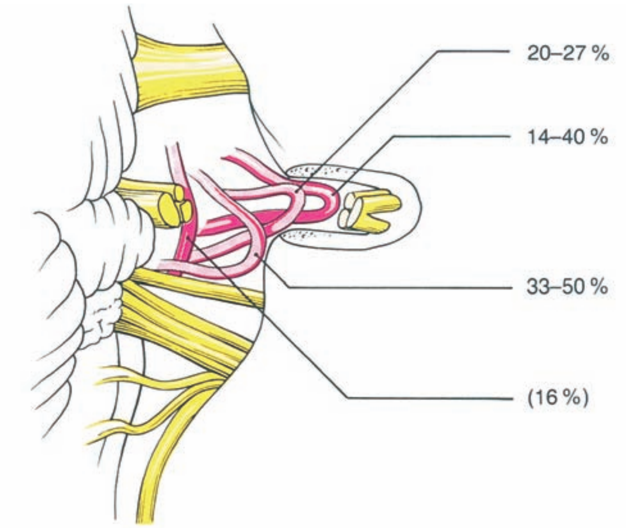


Fig. 2.**25** The various positions of the meatal loop of the anterior inferior cerebellar artery.

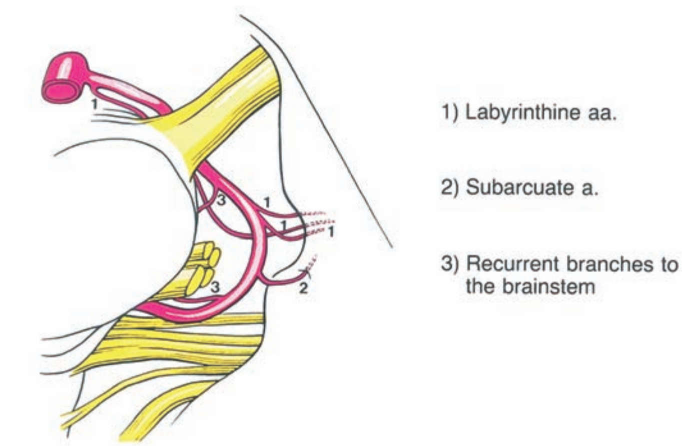


Fig. 2.**26** Anatomy of the branches of the anterior inferior cerebellar artery.

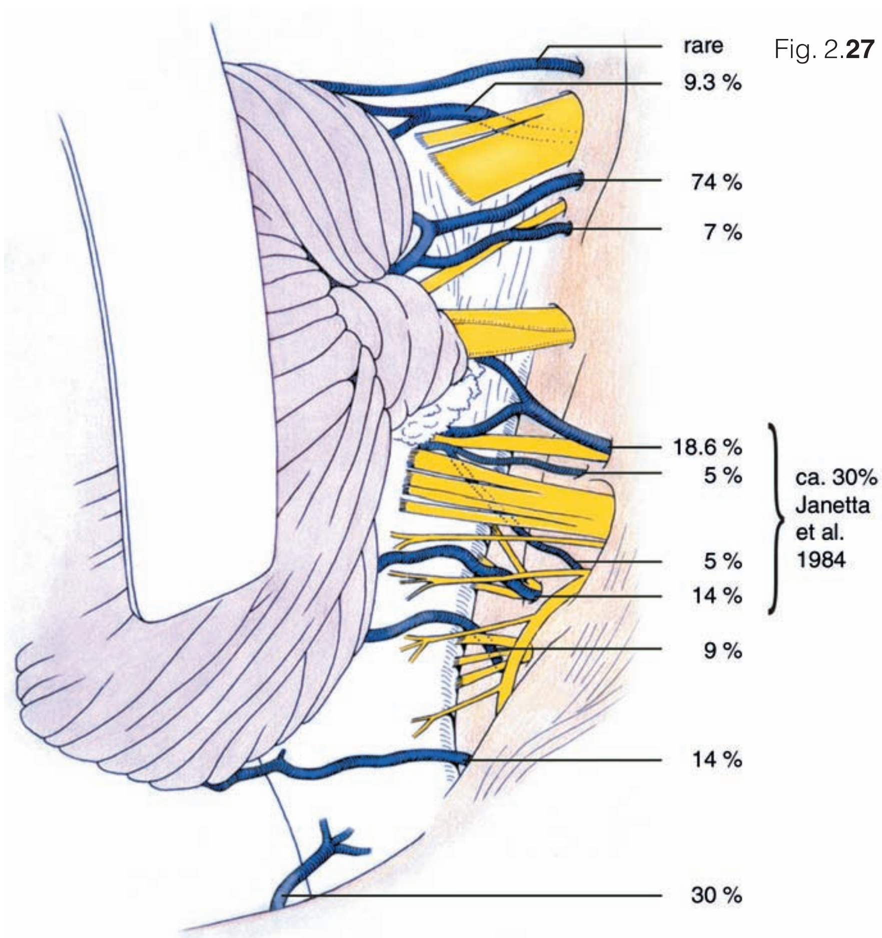


Fig. 2.**27** Anatomy of the transcisternal veins.