Pu Dai
Vincent C Cousins
Yue-shuai Song
Xue Gao
Editors

Stereoscopic Anatomical Atlas of Ear Surgery

PEOPLE'S MEDICAL PUBLISHING HOUSE
PMPH

Springer

Stereoscopic Anatomical Atlas of Ear Surgery

Pu Dai • Vincent C Cousins
Yue-shuai Song • Xue Gao
Editors

Stereoscopic Anatomical Atlas of Ear Surgery

PMPH PEOPLE'S MEDICAL PUBLISHING HOUSE

Springer

Editors
Pu Dai
College of Otolaryngology Head and Neck Surgery
Chinese PLA General Hospital
Beijing
China

Yue-shuai Song
Department of Otolaryngology Head and Neck Surgery
Beijing Friendship Hospital, Capital Medical University
Beijing
China

Vincent C Cousins
Department of Ear Nose and Throat Surgery
Alfred Hospital
Melbourne
Australia

Department of Surgery
Monash University
Melbourne
Australia

Xue Gao
Department of Otolaryngology Head and Neck Surgery
PLA Rocket Force Characteristic Medical Center
Beijing
China

ISBN 978-981-16-0926-8 ISBN 978-981-16-0927-5 (eBook)
https://doi.org/10.1007/978-981-16-0927-5

Jointly published with People's Medical Publishing House, PR of China

This Springer imprint is published by the registered company Springer Nature Singapore Pte Ltd.
The registered company address is: 152 Beach Road, #21-01/04 Gateway East, Singapore 189721, Singapore

Preface

Anatomy is the basis of medical discourse (Hippocrates, De locis in homine 2). Ear surgeons would be no more than armchair strategists if they lacked anatomical knowledge and practical experience. Even audiological physicians would find it difficult to understand the etiology and pathogenesis of audiological disease if they lacked anatomical knowledge. Commencing in the 1960s, otomicrosurgery, otoneurosurgery, and lateral skull base surgery have developed rapidly, greatly aided not only by research into the pathogenic mechanisms of ear diseases but also by detailed studies on temporal bone and skull base anatomy. Today, practitioners must absorb a great deal of information and keep up with the newest development in this field.

Otolaryngologists and scholars around the world have published many, exquisitely clear, ear surgery monographs over the past few decades. These publications support both younger ear surgeons and other ENT professionals. However, ear anatomy is so exquisite and complex that traditional two-dimensional (2D) media can only reveal basic morphological characteristics and spatial relationships partly; stereoscopic micrographs yield a true stereoscopic effect by perceiving depth, which are definitely better. In the 1990s, guided by Academician Si-chang Jiang, the College of Otolaryngology Head and Neck Surgery of the Chinese PLA General Hospital commenced research on 3D visual technology, initially presented in the book entitled *Stereoscopic Anatomical Atlas of Ear Surgery (You-jun Yu, Pu Dai, etc., People's Military Medical Press, Beijing, 2006)*. We later published the first microsurgical stereoscopic atlas in China, entitled *Stereoscopic Surgical Atlas of Otomicrosurgery (Dong-yi Han and Pu Dai*, *People's Medical Publishing House, Beijing, 2009)*. This was well reviewed at home, being one of the top 100 original books honored by the Chinese General Administration of Press and Publications in 2011. Springer purchased the copyright and published an English version in 2017.

For this book, we prepared sophisticated surgical and photographic devices including *Zeiss* OPMI *Pentero* and *NC4* microscopes, a double light path photography system with *Canon EOS 5D* cameras, a *Medtronic* dynamic system, *SPIGGLE & THEIS* microscopic surgical instruments. In addition, we collected models of a cochlear probe electrode, vibrational sound bridge, and artificial auditory prostheses (*MED-EL*, *Cochlear*, *AB*, *SPIGGLE & THEIS*, *Kurz*, *Medtronic*). Professor Pu Dai performed all dissections illustrated in the book; 262 stereoscopic images were carefully selected. We collaborated with Professor Hao-bing Wang (Eaton-Peabody Laboratory, Massachusetts Eye & Ear Infirmary), and published, with thanks, 31 stereoscopic 3D reconstruction images using her 3D model. Thus, the book features 293 stereoscopic images showing the internal and external structures of the temporal bone.

Assisted by readers' feedback of our earlier *Stereoscopic Surgical Atlas of Otomicrosurgery*, we carefully explain each image in the new book and we approach ear anatomy in a logical manner. The images are taken from better camera angles presented in a logical sequence and seek to be as informative as possible. However, some errors are inevitable; we again welcome your valuable feedback and advice. Thank you.

Beijing, China Pu Dai

Acknowledgement

This work was supported by National Natural Science Foundation of China (61827805).

Contents

List of Contributors

Qing-ling Bi Department of Otolaryngology Head and Neck Surgery, China-Japan Friendship Hospital, Beijing, China

Chao-chan Cai College of Otolaryngology Head and Neck Surgery, Chinese PLA General Hospital, Beijing, China

Vincent C Cousins Department of Ear Nose and Throat Surgery, Alfred Hospital, Melbourne, Australia

Department of Surgery, Monash University, Melbourne, Australia

Pu Dai College of Otolaryngology Head and Neck Surgery, Chinese PLA General Hospital, Beijing, China

Ying Fu Department of Otorhinolaryngology, Qilu Hospital (Qingdao), Cheeloo College of Medicine, Shandong University, Qingdao, China

Bo Gao College of Otolaryngology Head and Neck Surgery, Chinese PLA General Hospital, Beijing, China

Song Gao Department of Otolaryngology Head and Neck Surgery, The 909th Hospital of PLA, South-East Hospital Affiliated to Xiamen University, Zhangzhou, China

Xue Gao Department of Otolaryngology Head and Neck Surgery, PLA Rocket Force Characteristic Medical Center, Beijing, China

Ping Gu Department of Otolaryngology Head and Neck Surgery, Shenzhen Children's Hospital, Shenzhen, China

Chang Guo College of Otolaryngology Head and Neck Surgery, Chinese PLA General Hospital, Beijing, China

Bing Han College of Otolaryngology Head and Neck Surgery, Chinese PLA General Hospital, Beijing, China

Ming-yu Han College of Otolaryngology Head and Neck Surgery, Chinese PLA General Hospital, Beijing, China

Sha-sha Huang College of Otolaryngology Head and Neck Surgery, Chinese PLA General Hospital, Beijing, China

Yu-bin Ji Department of Otolaryngology Head and Neck Surgery, Beijing Tsinghua Changgung Hospital, Beijing, China

Yi Jiang Department of Otolaryngology Head and Neck Surgery, Shanghai Ninth People's Hospital, Shanghai Jiao Tong University School of Medicine, Shanghai, China

Zhan-guo Jin Department of Otolaryngology Head and Neck Surgery, Air Force Medical Center, Beijing, China

Su Jeong Lee Department of Otolaryngology Head and Neck Surgery, Peking University International Hospital, Beijing, China

Jia-nan Li College of Otolaryngology Head and Neck Surgery, Chinese PLA General Hospital, Beijing, China

Jian-hui Li College of Otolaryngology Head and Neck Surgery, Chinese PLA General Hospital, Beijing, China

Qi Li Department of Otolaryngology Head and Neck Surgery, Children's Hospital of Nanjing Medical University, Nanjing, China

Xiao-hong Li Department of Otolaryngology Head and Neck Surgery, Beijing Children's Hospital, Capital Medical University, Beijing, China

Yun-juan Lin Department of Otolaryngology Head and Neck Surgery, Peking University International Hospital, Beijing, China

Jun Liu College of Otolaryngology Head and Neck Surgery, Chinese PLA General Hospital, Beijing, China

Ya-qing Liu Department of Otolaryngology Head and Neck Surgery, Children's Hospital of Nanjing Medical University, Nanjing, China

Kun Ma Department of Otolaryngology Head and Neck Surgery, Peking University International Hospital, Beijing, China

Li-li Ren College of Otolaryngology Head and Neck Surgery, Chinese PLA General Hospital, Beijing, China

Sen-yao Shao Department of Otolaryngology Head and Neck Surgery, Peking University International Hospital, Beijing, China

Yue-shuai Song Department of Otolaryngology Head and Neck Surgery, Beijing Friendship Hospital, Capital Medical University, Beijing, China

Yu Su Department of Otolaryngology Head and Neck Surgery, Chinese PLA General Hospital Affiliated Hainan Hospital, Sanya, China

Bao-chun Sun Department of Otolaryngology Head and Neck Surgery, The Fourth Medical Center of PLA General Hospital, Beijing, China

Yi Sun Department of Otolaryngology Head and Neck Surgery, General Hospital of Central Theater Command, Wuhan, China

Yi-chen Wan Department of Otolaryngology Head and Neck Surgery, Peking University International Hospital, Beijing, China

Guo-jian Wang College of Otolaryngology Head and Neck Surgery, Chinese PLA General Hospital, Beijing, China

Hui-bing Wang Department of Otolaryngology Head and Neck Surgery, The Third Medical Center of PLA General Hospital, Beijing, China

Meng-hang Wang Department of Otolaryngology Head and Neck Surgery, Peking University International Hospital, Beijing, China

Wei-qian Wang Department of Otolaryngology Head and Neck Surgery, PLA Rocket Force Characteristic Medical Center, Beijing, China

Feng Xin Department of Otolaryngology Head and Neck Surgery, Second Hospital of Shanxi Medical University, Taiyuan, China

Jun-fang Xue Department of Otolaryngology Head and Neck Surgery, Peking University International Hospital, Beijing, China

Xu-kun Yan Department of Otolaryngology Head and Neck Surgery, Beijing Tiantan Hospital, Capital Medical University, Beijing, China

Fei Yu College of Otolaryngology Head and Neck Surgery, Chinese PLA General Hospital, Beijing, China

Yong-yi Yuan College of Otolaryngology Head and Neck Surgery, Chinese PLA General Hospital, Beijing, China

De-jun Zhang Department of Otolaryngology Head and Neck Surgery, The Second Hospital of Jilin University, Changchun, China

Hong-lei Zhang Department of Otolaryngology Head and Neck Surgery, Air Force Medical Center, PLA, Beijing, China

Jian-dong Zhao College of Otolaryngology Head and Neck Surgery, Chinese PLA General Hospital, Beijing, China

Yu-hua Zhu College of Otolaryngology Head and Neck Surgery, Chinese PLA General Hospital, Beijing, China

About the Editors

Pu Dai is a surgeon-scientist, full professor, and the Chair of the Scientific Committee, College of Otolaryngology Head and Neck Surgery, Chinese PLA General Hospital, Chinese PLA Medical School. Professor Dai specializes in otology, skull base surgery, and cochlear implantation surgery. His research has focused on minimal access and difficult cochlear implantation surgery, hearing preservation, and the genetics of hearing loss. Professor Dai initiated his pioneering three-dimensional (3D) morphological research on the temporal bone in 1990, and he authored the first *Stereo Anatomical and Surgical Atlas of the Temporal Bone* in China (2006) and a 3D atlas of micro ear surgery in the world (2017). Professor Dai has published more than 70 peer-reviewed journal articles worldwide and 160 journal articles in Chinese. He is the chief editor of four books in the field of otological surgery, anatomy, and inherited hearing loss. He is also the Principal Investigator for more than 10 grants, including those sponsored by the National Key Research and Development Project of China and the National Natural Science Foundation of China. His honors include two Second Grade Prizes in the National Science and Technology Progress Awards (for controlling birth defects causing severe-to-profound hearing impairment), one Seeking Truth Award, and a nomination as a National Distinguished Young and Middle-aged Specialist. He was the Chair of the Organizing Committee and the Conference Secretary for the Asia-Pacific Symposium on Cochlear Implantation and Related Science (APSCI) (2015) and is an APSCI board member.

Vincent C Cousins graduated in Medicine from Monash University, Melbourne, Australia, in 1974. He completed his advanced surgical training in Otolaryngology Head & Neck Surgery in Melbourne (FRACS) in 1984. He then undertook a Head and Neck and Skull Base fellowship with Professor Donald Harrison in London, England, in 1984/1985, and an Otology fellowship with Professor Dietrich Plester in Tübingen, Germany, in 1986. He has practiced in Melbourne in otology and neurotology since then. He is currently Principal Specialist and Head of the ENT-Otoneurology Unit at the Alfred Hospital, Melbourne, and Adjunct Clinical Associate Professor in Surgery at Monash University. He is Past President of the Australian Society of Otolaryngology Head & Neck

Surgery. He has served the Royal Australasian College of Surgeons as Councilor, Chief Examiner (OHNS), and Board Chair of the Academy of Surgical Educators. He has been awarded Distinguished Service Awards from both of these organizations. He is a Past President and Life Member of the Neurotology Society of Australia. He was Visiting Professor in the Department of Otolaryngology, Sun Yat Sen University, Guangzhou, China, from 2003 to 2009. He was the Wong Hua Yuen Distinguished Scholar, Hong Kong University, in 2004. He was appointed as the JLO Visiting Professor of the Royal Society of Medicine Otology Section, London, UK, in 2007. He is a member of the Executive Board and Regional Secretary of the International Federation of Otolaryngological Societies (IFOS) for South East Asia, Western Pacific, and Oceania. His research interests include the management of acoustic neuroma, paragangliomas of the head and neck, facial paralysis, and temporal bone trauma as well as outcome measures and quality of life in otology and lateral skull base surgery. He has published more than 50 peer-reviewed journal articles and book chapters and is a member of Editorial Board or Peer Review Panel of multiple international surgical journals. He has a particular interest in surgical education and skills training in otology and lateral skull base surgery and has directed and instructed on temporal bone dissection and skull base surgery courses in Australia, Africa, and China over the last 30 years. He has been part of the Organizing and Scientific Committees and/or Invited Faculty member of more than 100 international Congresses or Courses on Otology and Skull Base Surgery.

Yue-shuai Song is an associate chief physician of otolaryngology head-neck surgeon working in Beijing Friendship Hospital. He graduated from the Nankai University Medical School, in Tianjin, China, in 2009 and later completed his otolaryngology training and was awarded a doctoral degree from the Nankai University Medical School in 2012. He undertook a further 3 years of postdoctoral training at the Chinese PLA General Hospital from 2012 to 2015. He has practiced as an otolaryngology head-neck surgeon in Beijing Friendship Hospital since 2015. He has a great deal of experience in the anatomy of the temporal bone and skull base and has focused his research on cochlear implantation and the three-dimensional (3D) morphology of the temporal bone. He participated in the publication of the first 3D atlas of micro ear surgery and anatomy as vice and chief editor in 2009 and 2016, respectively. Yue-shuai Song has published 8 articles in SCI journals and 18 articles in Chinese journals. He holds seven national patents. He is in charge of the anatomy training program in ear surgery at Beijing Friendship Hospital.

Xue Gao is an associate chief physician and Vice Chair of otolaryngology of Chinese PLA Rocket Force Characteristic Medical Center, with special interest in middle ear and cochlear implantation surgery. She graduated from the Fourth Military Medical University, in Xi'an, China, in 2002 and later completed her otolaryngology training and was awarded a doctoral degree from the Fourth Military Medical University in 2008. She undertook a further 5 years of postdoctoral training with Professor Pu Dai at the Chinese PLA General Hospital from 2011 to 2016. She specialized in otology, anatomy of the temporal bone, and the genetics of hearing loss and published 22 articles in international peer-reviewed journals. She is currently secretary of CSAH (Chinese Society of Artificial Hearing).

Overview

1

Yue-shuai Song, Song Gao, Pu Dai, Xue Gao, and Vincent C Cousins

Temporal Bone Dissection Instruments and Laboratory

Yue-shuai Song

Instruments

Temporal bone dissection covers the external, middle, and inner ear, and may extend to the occipital bone, parotid gland and cranial cavity. Therefore, a well-equipped laboratory and a broad range of dissecting instruments are strongly recommended.

Y.-s. Song (✉)
Department of Otolaryngology Head and Neck Surgery, Beijing Friendship Hospital, Capital Medical University, Beijing, China

S. Gao
Department of Otolaryngology Head and Neck Surgery, The 909th Hospital of PLA, South-East Hospital Affiliated to Xiamen University, Zhangzhou, China

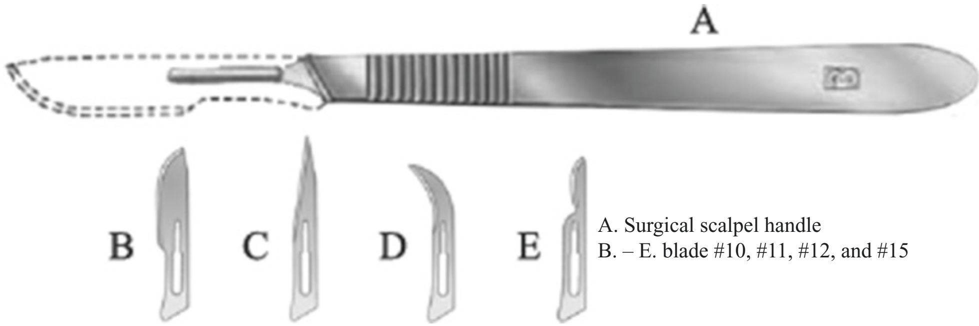
P. Dai
College of Otolaryngology Head and Neck Surgery, Chinese PLA General Hospital, Beijing, China

X. Gao
Department of Otolaryngology Head and Neck Surgery, PLA Rocket Force Characteristic Medical Center, Beijing, China

V. C. Cousins
Department of Ear Nose and Throat Surgery, Alfred Hospital, Melbourne, Australia

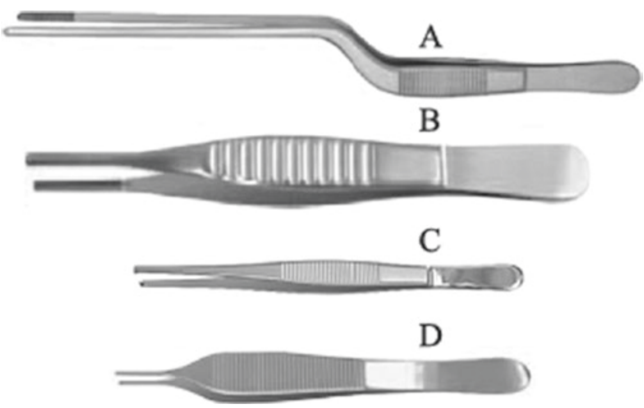
Department of Surgery, Monash University, Melbourne, Australia

P. Dai et al. (eds.), *Stereoscopic Anatomical Atlas of Ear Surgery*, https://doi.org/10.1007/978-981-16-0927-5_1



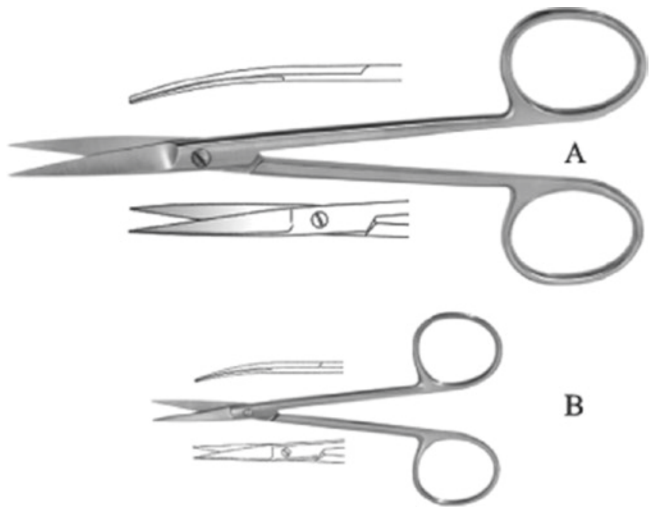
A. Surgical scalpel handle
B. – E. blade #10, #11, #12, and #15

Fig. 1.1 Scalpels



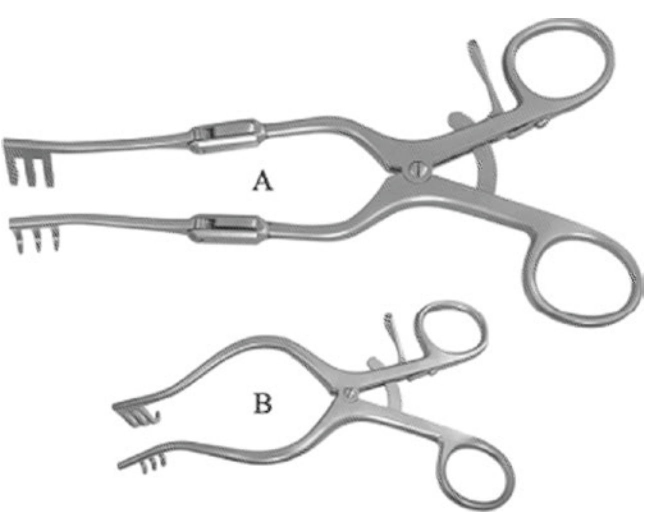
A. Lucae bayonet-shaped forceps B. Dissecting forceps
C. Ophthalmic forceps D. Fine tissue forceps

Fig. 1.2 Forceps



A. Dissecting scissors (straight and curved)
B. Ophthalmic scissors (straight and curved)

Fig. 1.3 Scissors



A. Double joint mastoid retractor B. Single joint mastoid retractor

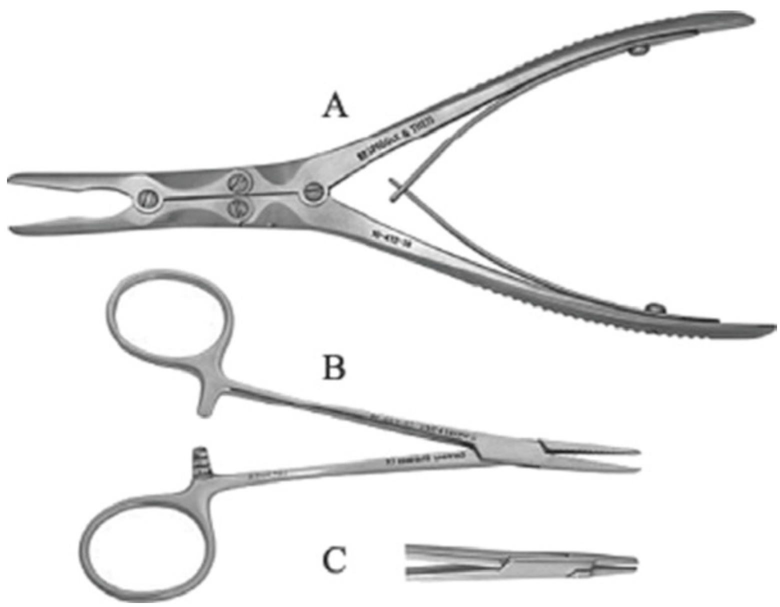
Fig. 1.4 Retractors

A. Round chisel B. Hammer C. Flat chisel

Fig. 1.5 Hammer and chisels

A. Faraboeuf periosteal elevator B. Cottle periosteal elevator C. Freer elevator

Fig. 1.6 Elevators



A. Beyer bone nibbler B. Vascular forceps C. Needle holder

Fig. 1.7 Forceps and needle holder

A. Handle
B. Heads of different sizes

Fig. 1.8 Curette

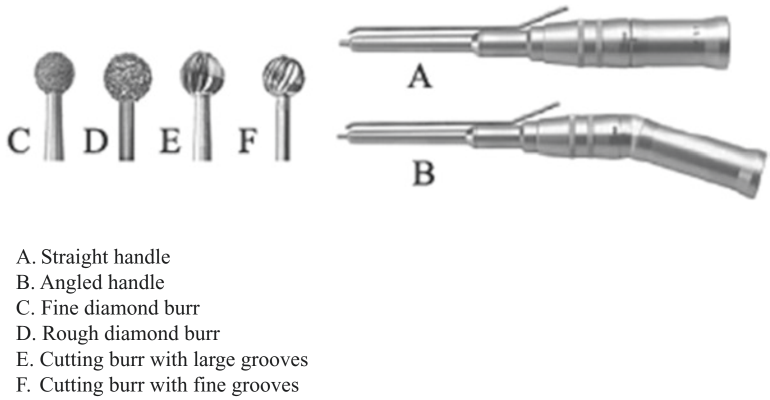


Fig. 1.9 Drill handles and burrs (ϕ: 0.6–7.0 mm)

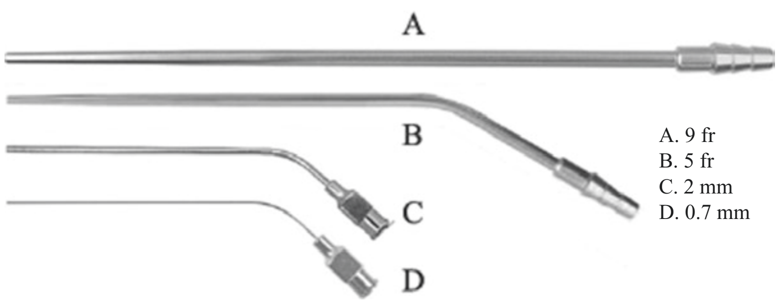


Fig. 1.10 Suction cannulas

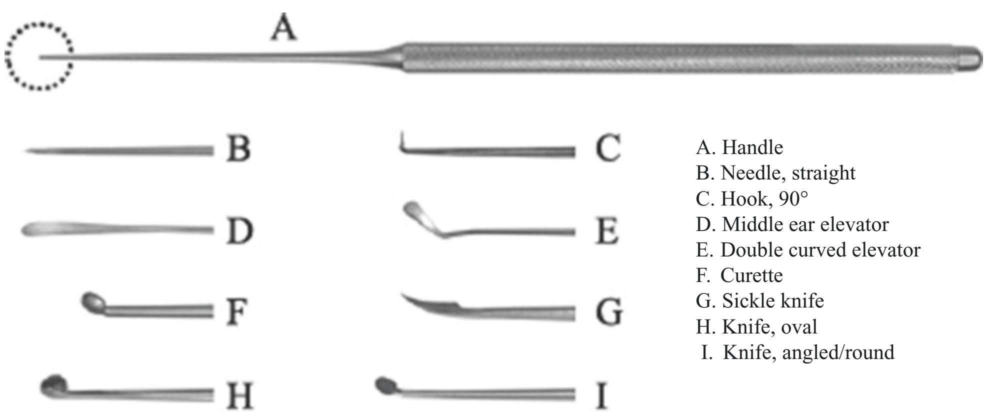


Fig. 1.11 Microsurgical instruments (straight handle)

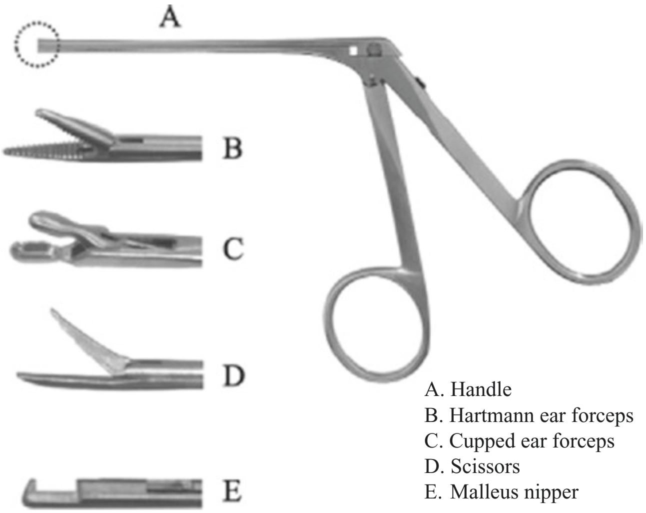
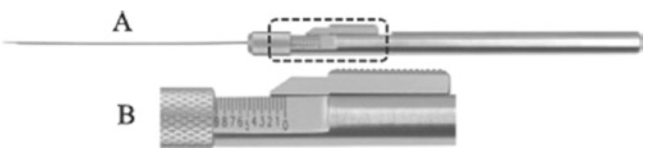


Fig. 1.12 Microsurgical instruments (forceps handle)

Fig. 1.14 Drill control system



A. Stapes measurement device
B. Ruler in the handle

Fig. 1.13 Stapes measurement device

Dissection Laboratory

The precise arrangements vary according to the available space. The items that should be taken into consideration are: (1) scale of the room; (2) number of dissection tables; (3) frequency of the anatomy program; (4) storage and management of specimens; (5) availability of equipment maintenance; (6) service staff; and (7) water, electricity, and cleaning systems.

Our laboratory has an area of about 100 m^2 and is equipped with water, electricity, and a cleaning system. There are 15 tables, each of which has a microscope (Carl Zeiss OPMI Pico or Kingtic YSX104) and a drill (Bien Air or XISHAN DK-ENT). There is a demonstration system, including a Carl Zeiss OPMI Universal S3 microscope and attached TV system. We have carried out temporal bone dissection courses in July and December every year since 1997.

Fig. 1.15 Temporal bone dissection course, Chinese PLA General Hospital

Fig. 1.16 Professor Pu Dai capturing three-dimensional pictures during temporal bone dissection for this book

Stereoscopic Anatomy of the Temporal Bone

Song Gao

Stereopsis and Stereo Images

The average adult inter-pupillary distance is 65 mm. The images on each retina are not exactly the same when we observe objects with both eyes at the same time, which is known as binocular vision. The perception of depth is created in the brain by the integration of the two different views, providing a stereoscopic vision of the objects being observed.

Stereo images mimic human binocular vision. A pair of photographs are taken from the left and right sides of an object at the same time and provide a stereo image when viewed through a stereoscope that preserves and reproduces the stereoscopic information.

Stereo images of microscopic ear and temporal bone surgery truly reproduce the surgical or anatomical field and provide more spatial information than two-dimensional (2-D) representations; such images help the observer or student better understand the spatial relationships between anatomical structures.

Brief History of the Development of Stereo Anatomy of the Temporal Bone

There is a temporal bone on each side of the skull, and each constitutes the floor of the ipsilateral middle cranial fossa and anterior wall of the posterior cranial fossa. Characterized by its small volume, irregular shape, subtle structure, and close proximity to a group of important structures, the temporal bone is the most complicated bony structure in the body. Its anatomy is the basis of otology.

A number of anatomical structures in the temporal bone are so small that they can hardly be observed with the naked human eye. Traditional anatomical images of the temporal bone are 2-D images, and it is difficult for beginners to gain an appreciation of the spatial arrangement of these anatomical structures in the temporal bone. The effective display of this 3-D spatial information is a challenge in the learning and studying of ear microsurgery. In the 1970s and 1980s, temporal bone tissue sections were used to develop three-dimensional (3-D) reconstructions. In China, Pu Dai took the first steps to depict the anatomy of the ear in three dimensions based on serial sections of celloidin-embedded temporal bones.

Pu Dai and colleagues published their *Stereo Anatomical and Surgical Atlas of Temporal Bone* utilizing a camera and stereo-photography. They achieved realistic stereovision when viewing the images through a stereoscope. At that time, the state of stereo photography technology was rudimentary and simulated binocular images by taking a pair of photos of the same anatomical areas from the left and right sides. Pu Dai later developed a stereo imaging system using an operating microscope (Patent No. *ZL200820078610.3*). The microscope has two image-collecting channels with two digital cameras mounted to record separate images during surgery. A pair of images are then viewed together using a stereoscope to provide a stereo image. This system provides real stereo vision of the surgical field. The *Stereo Operative Atlas of Micro Ear Surgery* published in 2009 by Dong-Yi Han and Pu Dai is the result of this research.

How to Achieve Stereo Vision Based for Use with the 3-D Atlas

Pu Dai, Yue-shuai Song, and Xue Gao

The most significant feature of this book is that all 293 anatomic and reconstruction images in the atlas contain 3-D elements. Readers can achieve stereo vision unaided or with the assistance of some simple tools. Here we introduce some methods to achieve the 3-D vision when viewing the images.

1. *Using presbyopia spectacles as an alternative stereoscope*

A set of +6.00D to +7.00D presbyopia spectacles (non-prescription reading glasses) can be used as a stereoscope. About 90% of readers can achieve 3-D vision with this system.

a. folded flat, b. unfolded for use, c. front view, d. side view

Fig. 1.17 Presbyopia spectacles and Viewing 3-D images of this book by presbyopia spectacles

Reverse the presbyopia spectacles so the lenses are close to the observer with the arms facing away, Place the frame over the images with the arms sitting on the outer edges of the images. Ensure each lens is centered over the corresponding image at a distance of approximately 15 cm. Some minor adjustments in positioning may be required to appreciate the 3-D view.

2. *Using a Loreo Lite 3-D viewer*

This is a simple folded card viewer with good quality lenses for viewing 3-D prints. These are made by Loreo Asia Ltd and generally easily obtained via the internet (http://www.loreo.com/pages/shop/loreo_products_online.html, amazon.com or other) and come with instructions: (1) This viewer may be used with or without eyeglasses. If you are severely long or short sighted, it is recommended that you keep your prescription glasses on. (2) The viewing panel still bulges a little in brand new viewers but settles in well after being erected and used. (3) Please note that this is not a "back-lit" viewer and works best when the 3-D prints are well lit but indirect light without reflection.

a. folded flat, b. unfolded for use, c. front view, d. side view

Fig. 1.18 Loreo Lite 3D viewer and viewing 3-D images of this book by Loreo Lite 3D viewer

3. *Using a foldable stereoscope*

The majority of readers can easily use the foldable stereoscope to yield the 3-D vision of anatomical scenes and reconstructed images of the temporal bone. In the Chinese version of this book, the foldable stereoscope is provided inside the back cover, see the below figures.

Inquiries about sourcing this viewer can be directed to mixueer0110@126.com.

a. Foldable stereoscope is attached inside the back cover of the book. b, c. front view and side view of positioning of the stereoscope.

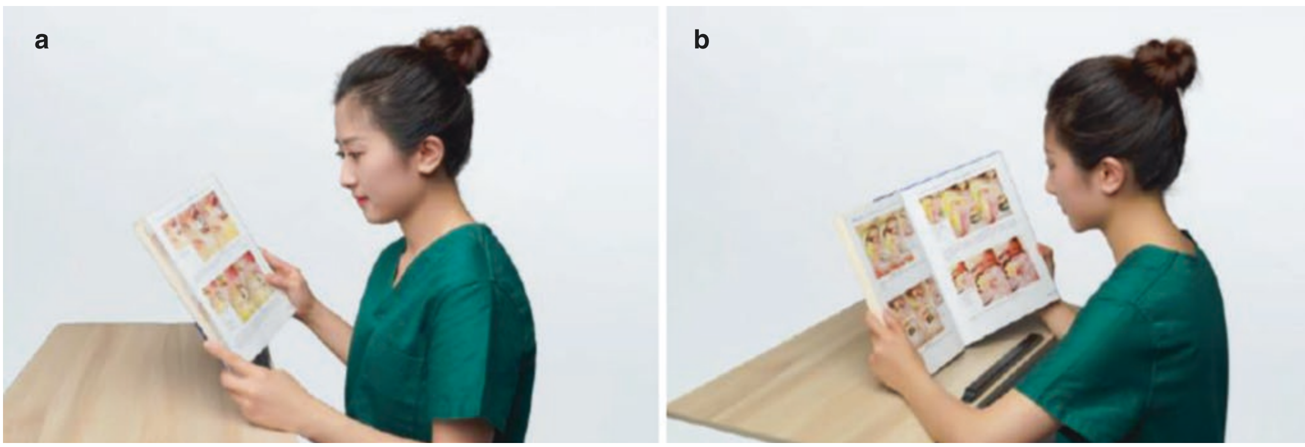
Fig. 1.19 Foldable stereoscope

Position the stereoscope with the lenses near the observer and the arms sitting in the middle of each side of the image pairs, the eye lenses are adjustable to accommodate interpupillary distance.

4. *Free-viewing with the naked eyes*

If none of the stereoscope systems above are available, you can try your naked eyes to achieve 3-D vision. This may be challenging but is an interesting way to appreciate the 3-D anatomic images unaided. Position your eyes equidistant from the center of the two images and defocus or attempt to focus beyond the images. Moving your head slightly toward or away from the image will often help the images to fuse and give you the intended 3-D view.

With practice, about 50% of subjects can succeed with this technique.



a. front-side view, b, back-side view

Fig. 1.20 Free-viewing the stereoscope image

View the stereoscopic image with naked eyes in a bright environment. The two important parameters are the distance from your eyes to the image (30~40 cm) and the diopter of your naked eyes; both can be varied. The eyes should be defocused and looking straight ahead. The fused image, or the central one if three are perceived, will appear in 3-D.

Note: Above four methods could also be applicable to our first 3-D atlas *Stereo Operative Atlas of Micro Ear Surgery* published in 2016 also by Springer.

Suggested Reading

Dai P, Han D-y, Cousins VC, et al. Stereo operative atlas of micro ear surgery. Singapore: Springer; 2017.

Dai P, Jiang S-c, Gu R. Computer assisted three-dimensional (3D) reconstruction and Mechanical model Establishment of Ossicular chain. Chin J Otorhinolaryngol. 1991;26(5):272–4.

Dai P, Shi L-y, Liu Y. The study and application of the three-dimensional anatomical atlas of temporal bone. Med J Chin People's Liberation Army. 2004;29(5):392–5.

Yu Y-j, Dai P, Liu Z. Stereo anatomical and surgical atlas of Temporal bone. Beijing: People's Military Medical Press; 2006.