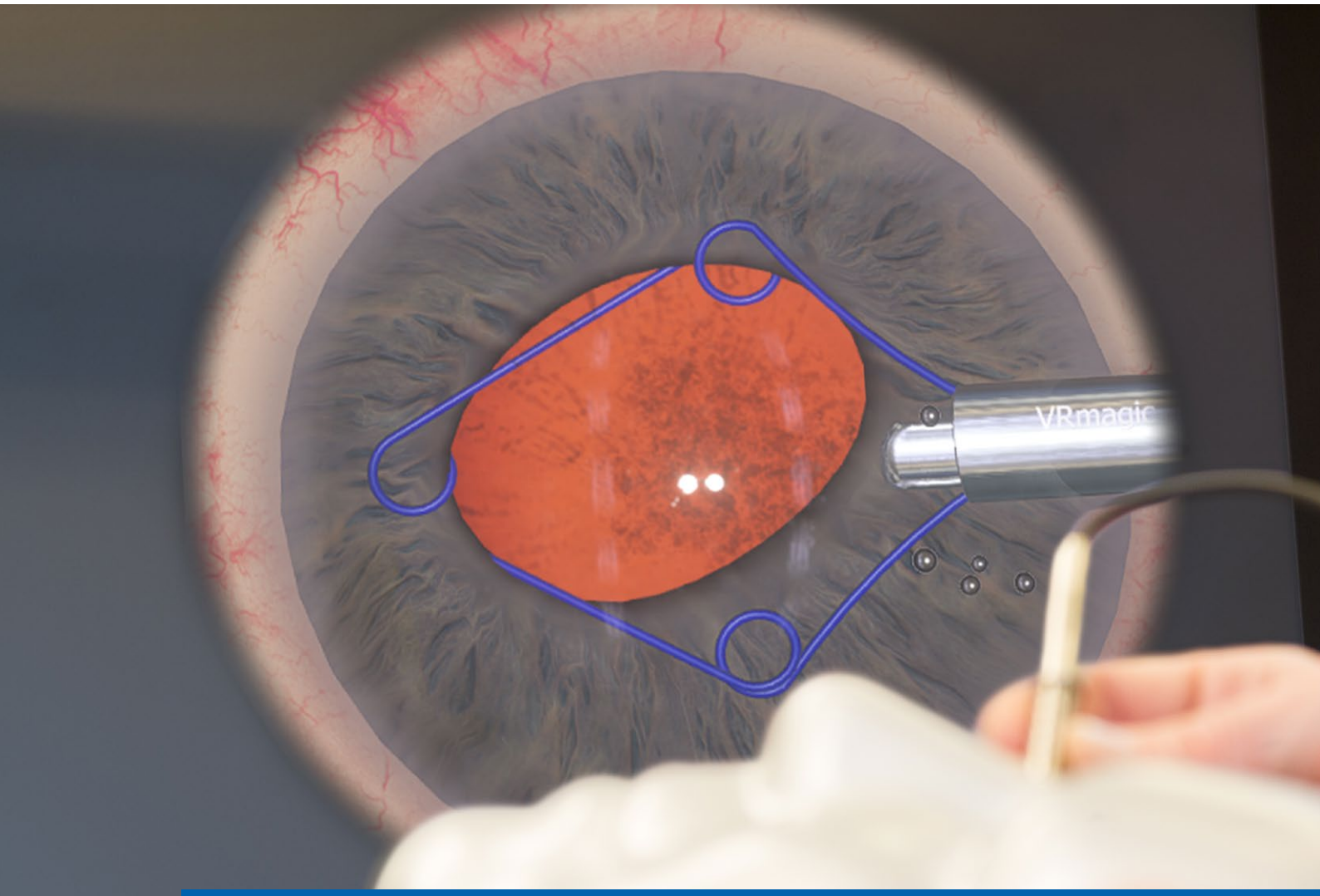

EYESI SURGICAL
Courseware Guide for Educators

Look closer. See further.

HAAG-STREIT SIMULATION

If you have any questions regarding the use of the device that are not answered in the product documentation, please contact

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Eyesi Surgical Simulator – Educator´s Guide to Courseware

Document version: 4.1
Date of issue: January 31, 2022
Applicable to: Eyesi Surgical Simulator software 3.8 and Eyesi Courseware 2.8

Table of Contents

1 Courseware overview

Benefits of using the Eyesi Surgical courseware

- Optimal learning for trainees: starts with basic skills training and proceeds to advanced multi-step surgical procedures
- Structured and systematic approach to simulator training
- Powerful evaluation tools, e.g. the Cataract Challenge course or performance comparison with other users around the world
- Comparability of training results with other trainees also using the courseware
- Little administrative effort – integrating the courseware into your institution's workflow only takes a few minutes per trainee.

1.1 Ready-to-use simulator curriculum

Learning step by step

The Eyesi Surgical courseware is a ready-to-use training curriculum on your Eyesi Surgical simulator. The courseware organizes the simulator training content into consecutively structured courses and tiers that are optimized to lead trainees step-by-step to expert performance. The Eyesi Surgical courseware provides you with an ideal basis for effectively integrating the Eyesi Surgical Simulator into your trainees' surgical education.

Courses and tiers

The curriculum consists of courses of increasing levels of difficulty, which are grouped into tiers. For example, the first tier contains introductory courses on basic microsurgical skills, while the last tier comprises increasingly complex surgical multi-step procedures and complications.

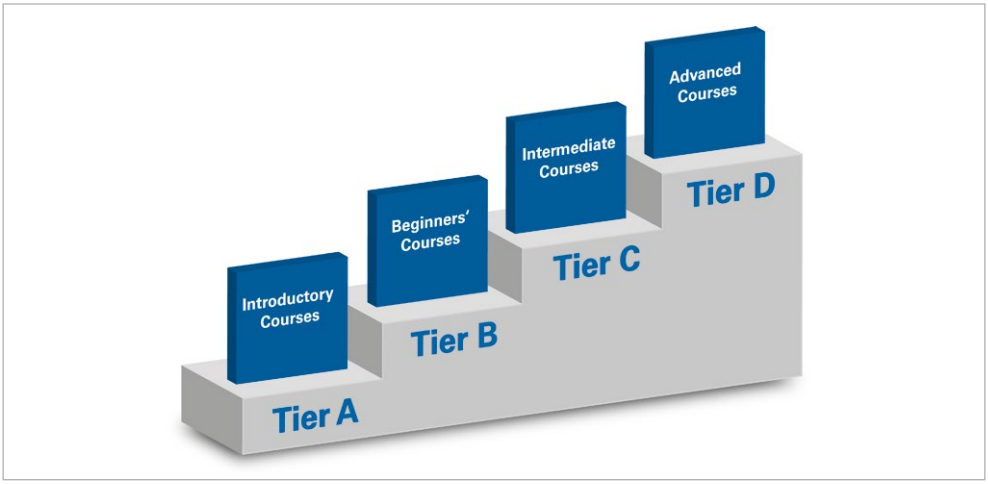


Fig. 1: Structure of the Eyesi Cataract courseware

Simulator and online courses

The Eyesi Surgical courseware contains simulator courses and online courses. Simulator courses are available on all Eyesi Surgical simulators and contain practical training tasks. Online courses are an optional part of the curriculum and available on the VRmNet website. They contain additional background information (text, videos, images) and instructions related to the practical simulator courses.

1.2 Educational concepts of the courseware

Deliberate practice

"Optimal learning takes place when a trainee performs a well-defined task at an appropriate level of difficulty. Informative feedback is essential to improvement, as are opportunities for repetition to correct mistakes and polish a skill before moving to the next task."[1]

Well-defined task

The Eyesi Surgical simulator breaks down complex surgical procedures into single, isolated tasks. This makes it easier to practice and refine core steps of cataract and vitreoretinal surgery.

The appropriate level of difficulty

The Eyesi Surgical courseware offers training at an appropriate level of difficulty. The curriculum for both cataract and vitreoretinal surgery is divided into courses for beginning to advanced trainees, allowing you to assign training units according to the current proficiency level of your residents.

Immediate feedback

While accomplishing training tasks, trainees are be supported by vocal and visual guidance from the training system. At the end of each task a detailed performance summary is provided.

Opportunities for repetition

In simulation, it is possible to create an exercise designed to teach a single, basic skill, while eliminating other distractions. Surgical tasks can be repeated in exactly the same setting until they are mastered. In addition, complications can be added under controlled conditions. The opportunity to try different options and see the consequences leads to a judgement of surgical settings based on experience – without actually injuring a patient.

Objective assessment

Further evaluation tools of the Eyesi Surgical simulator allow both you and your trainees to keep track of learning progression over time, for example with online and PDF training reports, performance comparison, or the Cataract Challenge course, a special benchmark course.

1.3 How trainees progress through the courseware

The Eyesi Surgical courseware provides several mechanisms that ensure your trainees can progress through the courses independently while meeting defined quality standards and receiving objective feedback on every step they make.

Automatic progression

Trainees start with the first tier, which is called CAT-A for cataract surgery or VRT-A for vitreoretinal surgery. The successful completion of the first tier automatically unlocks the next tier. This way, trainees will progress through the courseware according to their individual skill development.

INFO	**Deactivating automatic progression**

You can deactivate the automatic progression, e.g. to better control your residents´ progress or to synchronize the simulator-based training with a medical curriculum.

It is also possible to lock or unlock single courses to tailor training content to the specific training needs of individual users. For more information on (un)locking courses and tiers, please refer to the Eyesi Surgical administrator guide.

Scoring gates

Each course contains several tasks in a given order. To complete a task successfully, trainees have to achieve a required minimum score, for example 50 of 100 points in tier CAT-A. This minimum score is called scoring gate. The scoring gate increases in higher tiers.

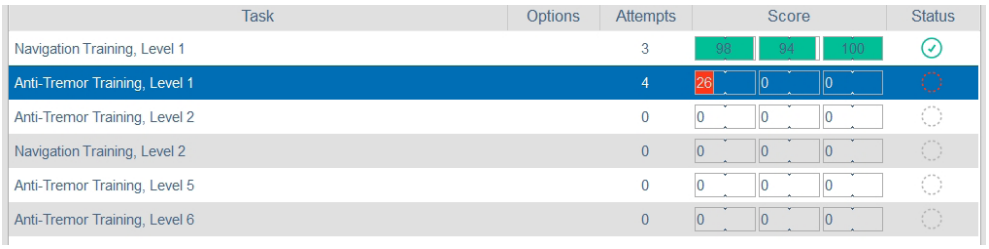


Fig. 2: Individual tasks of a course. The “Score” column is divided into three bars, one for each required attempt (reliability gates).

Reliability gates

Throughout the Eyesi courseware, each task of a simulator course has to be completed successfully several times in succession (mostly three times). This is what we call “reliability gate”. Reliability gates ensure high training intensity and reproducible results.

Immediate feedback

The Eyesi Surgical Simulator offers vocal and visual guidance and feedback on the trainee’s performance. Messages are displayed in the microscope view, for example to provide warnings if something is going wrong. In more advanced courses, all guidance options have been intentionally deactivated.

Objective assessment

At the end of each task, the trainee is presented with an objective performance summary. The task score is made up of attained objectives and penalty points, e.g. for injuries caused or inefficient use of instruments. Trainees can also view a replay of their virtual surgery with a summary of the mistakes they made, which helps to better judge the own performance.

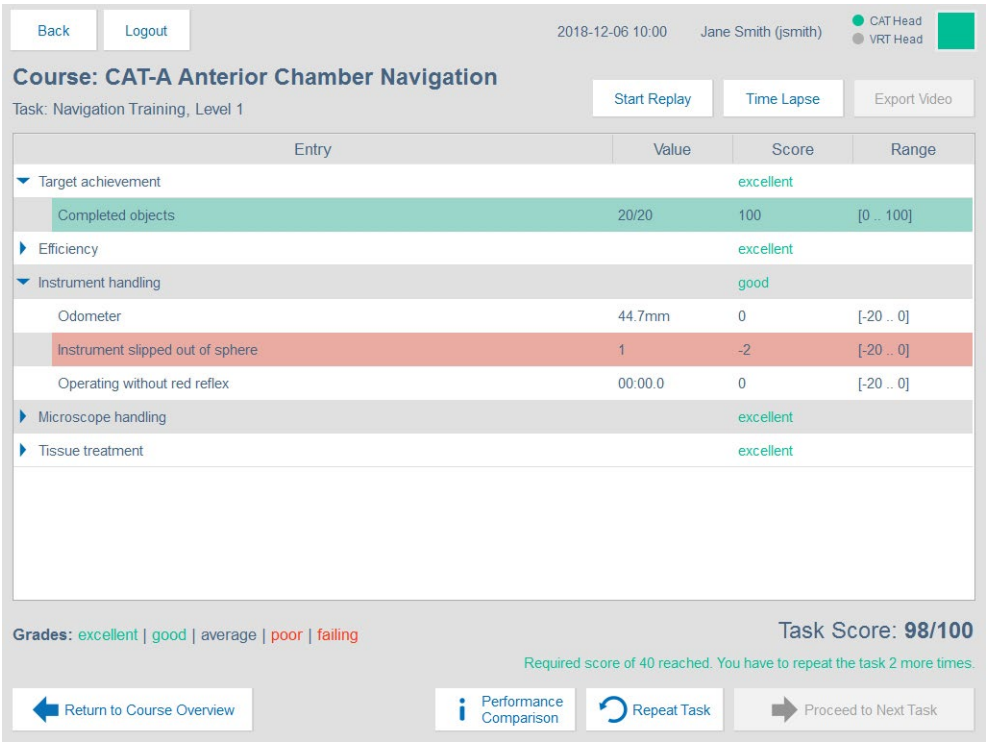


Fig. 3: Evaluation Screen

Online courses

In addition to the simulator courses, there are online courses. Online courses are available on the VRmNet website for residents training on networked simulators. By default, the online courses are optional and do not have to be completed. For more information on online courses, please read ➲ section 3.4 on page 22.

1 K.A. Ericsson et al, The Role of Deliberate Practice in the Acquisition of Expert Performance, Psychological Review, Vol. 100 No. 3, 363-406, 1993

2 Deploying the courseware

Eyesi Surgical can be used as a standalone device or it may be connected to VRmNet, the web-based training platform by Haag-Streit Simulation. To get the most out of the Courseware, Eyesi Surgical should be connected to VRmNet through Internet.

Regardless of which mode you are using, the following basic steps are required to deploy the Eyesi Surgical courseware in your institution.

1. Create an individual user account for each trainee. Assign each user account to the user group "Eyesi Courseware".
2. Provide the user accounts to your trainees.
3. Your trainees log in with their user accounts and start training.
4. Check your trainees' progress regularly during the training.

INFO	**VRmNet or standalone device**

Simulator connected to VRmNet

VRmNet synchronizes training data between connected simulators and a central server. VRmNet offers comfortable online user administration, online access to training data and peer group comparison, as well as online courses and automatic software updates. If your simulator is connected to VRmNet, you can manage the complete simulator training online.

➲ For information on deploying the courseware with VRmNet, please refer to 2.1 on page 9.

Simulator as standalone device

If your simulator is not connected to VRmNet, it can be used as a standalone device. Users need to be created directly on the simulator, and training reports can be exported as a PDF file.

➲ For information on deploying the courseware with a standalone device, please refer to 2.2 on page 14.

2.1 Deploying the courseware with VRmNet

2.1.1 Creating user accounts

INFO	Further information on VRmNet
For a detailed description of creating simulator users in VRmNet, please refer to **Help** > **User Management** > **Creating and Editing Users** on the VRmNet website.	

The trainee user accounts you create on VRmNet will be valid for both the VRmNet website and the simulator.

1. Visit the VRmNet website using your URL for educator login.
   Example: www.yourinstitution.vrmnet.com/educator
2. Log in with your educator account.
3. Choose **System Administration** > **Eyesi Surgical** > **Users**.
4. To create a single user, click **Create user**. To create several users at once by importing a spreadsheet, click **Import users from spreadsheet**.

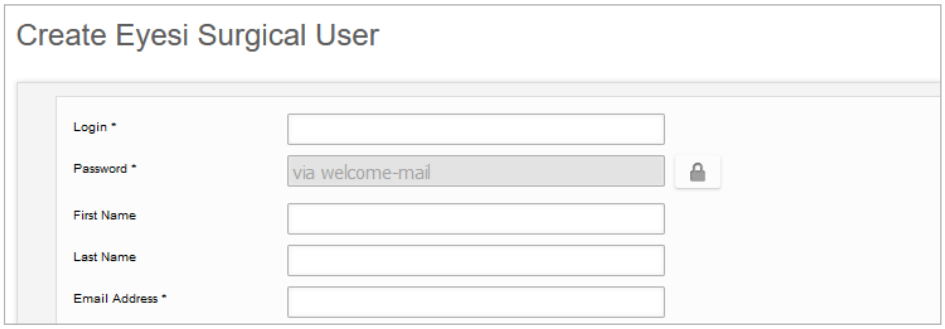


Fig. 4: Creating a user on VRmNet

5. Assign the users to the **Eyesi Courseware** group.
6. We recommend setting the following options during user creation.
   Access to simulator: "orientation course first" (trainees need to view a short online introduction on simulator usage).
   Send welcome email: "yes" (trainees will receive an automatic email with their user credentials and further instructions).

2.1.2 Providing the user accounts to trainees

Welcome email activated

If you activated the **Send welcome email** checkbox while creating the users, users will receive an automatic email with their login credentials for VRmNet and the simulator.

The email will prompt the trainees to specify a password on VRmNet.

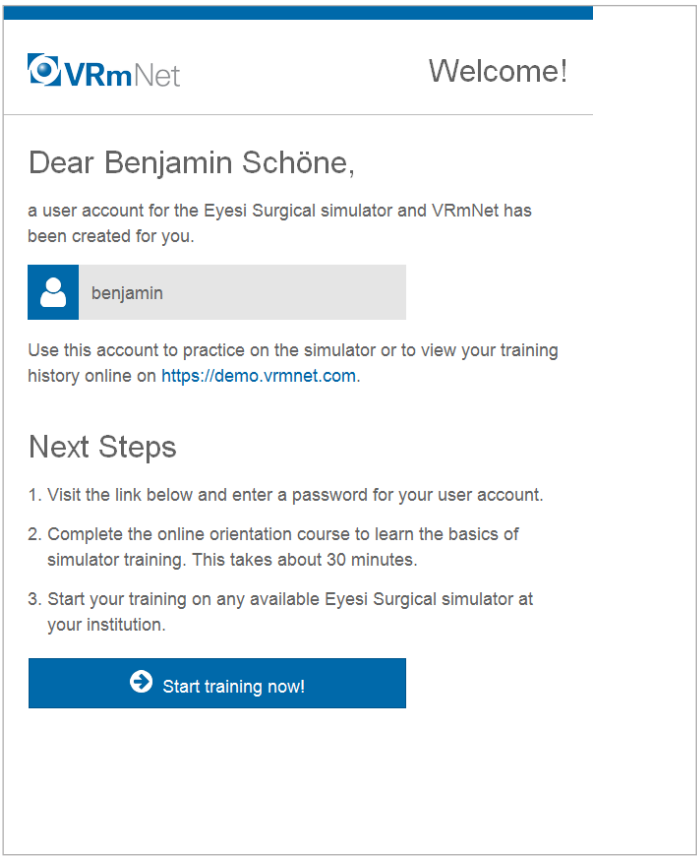


Fig. 5: Welcome email with user name and next steps

Welcome email not activated

If you did not activate the **Send welcome email** checkbox while creating the new users on VRmNet, please notify the users and let them know their user names and passwords.

2.1.3 Trainee login

Online orientation course

If you activated the option **Orientation course first** during user creation, trainees need to complete a short online orientation on VRmNet with videos and explanations on simulator usage. Access to the simulator is unlocked after completion.

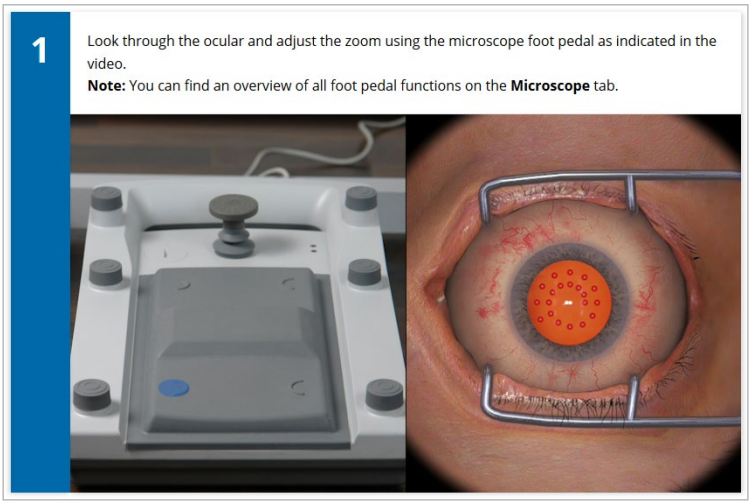


Fig. 6: Online orientation guide on VRmNet.com

Simulator login

After completing the online orientation course on VRmNet (and, optionally, further online medical courses), trainees can log in to the simulator with their user account and start their first training task. Please refer to the Eyesi Surgical User Guide for further information on training on Eyesi Surgical.

Online medical courses

Additional online medical courses on VRmNet provide background information and help trainees master the practical simulator tasks. Online medical courses are an optional part of the Eyesi Surgical courseware (➲ section 3.4 on page 22).

Online training reports

Trainees can log in to the VRmNet website using the URL for trainee login and view their training statistics.

2.1.4 Checking your trainees' progress

1. Visit the VRmNet website using your URL for educator login.
   Example: www.yourinstitution.vrmnet.com/educator
2. Log in with your educator account.
   - ▷ You can view the following training statistics.

INFO	Further information on VRmNet
For a detailed description of the available training statistics, please refer to **Help** > **Training Overview** on the VRmNet website.	

Performance overview

Choose **Training Overview** > **Eyesi Surgical** > **Performance Overview** for a performance comparison of your users with other users from around the world. Percentile values make it easy to assess your users' skill levels.

Login	Name	Class	Total Training Time	Completed Tasks	Av. Initial Performance [PCTL]	Av. Time to Gate [PCTL]	Av. Peak Performance [PCTL]	Challenge Course three) [/500 P
fernandezj	Dezjooun Fernan	2017	31 h 13 min	102	63	36	80	339
havesiont	Lois Campbell		17 h 25 min	102	48	38	50	404
stent1977	Johnny Falls		9 h 10 min	94	75	60	67	418
floody	Erica Wadsworth	2017	15 h 04 min	88	45	37	43	192.3
foomescree74	Tracy Taylor	2017	6 h 31 min	87	56	68	50	182

Fig. 7: Performance overview on VRmNet

Courseware progress

Choose **Training Overview** > **Eyesi Surgical** > **Courseware Progress** for a progress overview of your trainees.

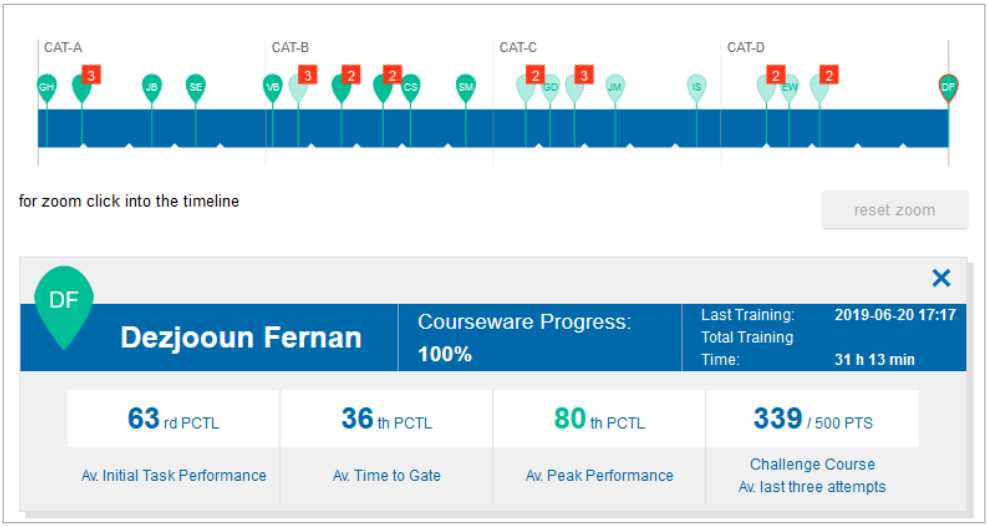


Fig. 8: Courseware progress on VRmNet

Training report

Choose **Training Overview** > **Eyesi Surgical** > **Training Report** for a detailed training report of a single user. You may generate PDF training certificates using the buttons at the top of the report.

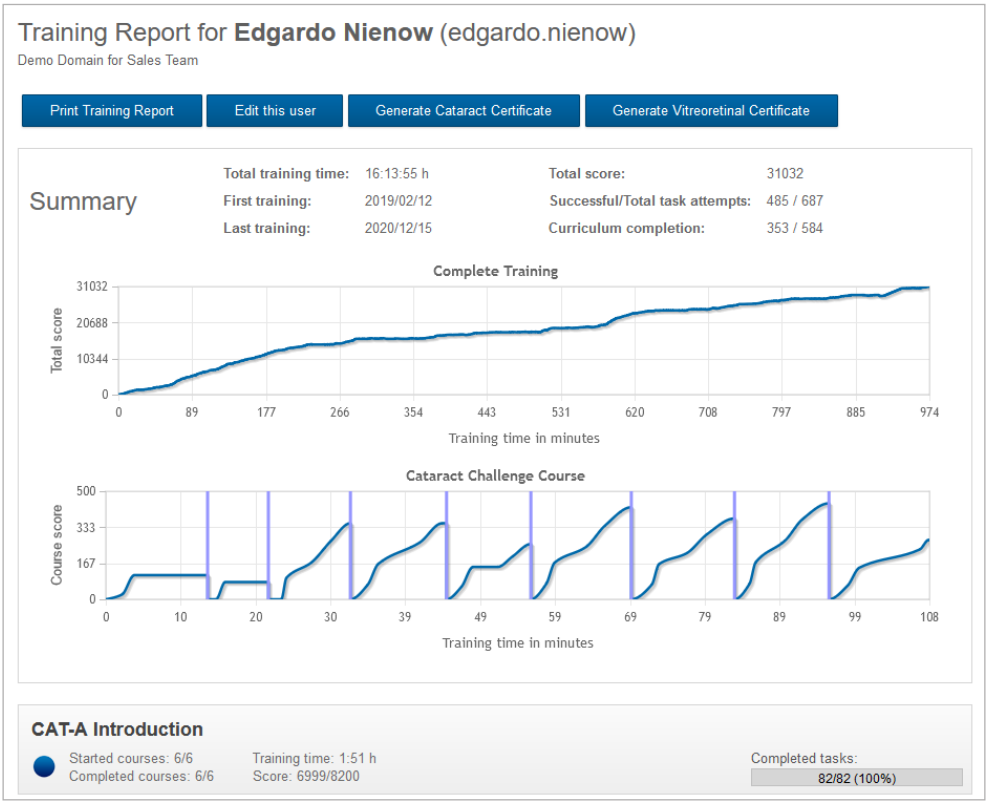


Fig. 9: Training report for a single user on VRmNet

Email notifications

Choose **System Administration** > **Eyesi Surgical** > **Classes** to set up automatic email notifications on your trainees' progress.

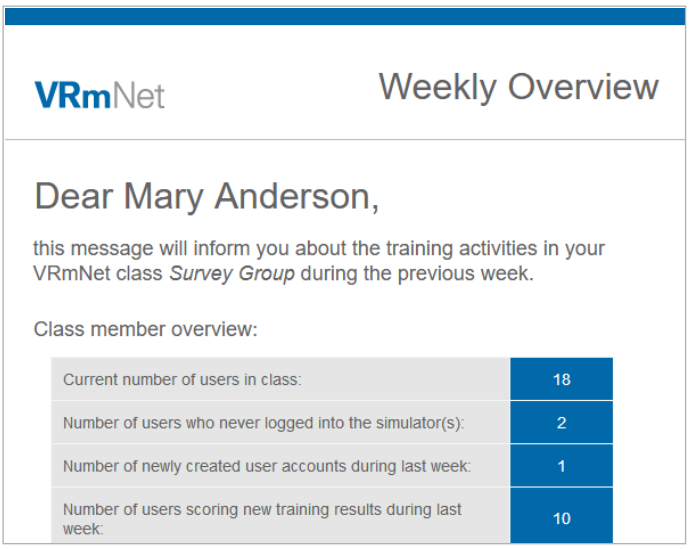


Fig. 10: Email notification

2.2 Deploying the courseware on a standalone device

INFO	**Further information in the Eyesi Surgical administrator guide**
This section provides an overview of the courseware administration on standalone devices. For a detailed description, please refer to the Eyesi Surgical administrator guide.	

2.2.1 Creating user accounts

1. Switch on the Eyesi Surgical simulator and log in with your administrator account.
2. Tap **User Administration** in the main menu.
3. Tap **New User(s)**.
   - ▷ A new screen is displayed.

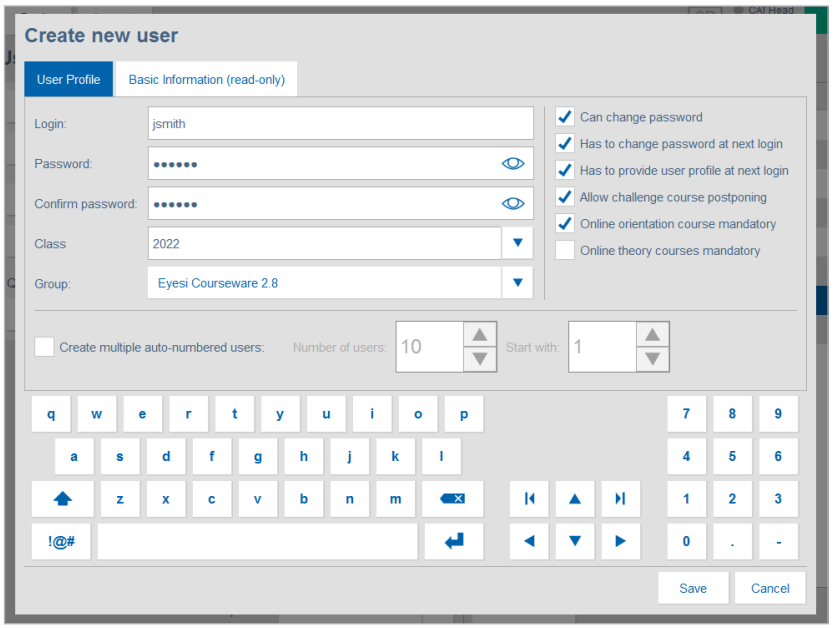


Fig. 11: Creating new users on Eyesi Surgical

4. Enter login name and password for the new user.
5. Enter a class name for the user in the **Class** field. Class names are optional and may be used to organize trainee groups.
6. Tap on the **Group** list and select **Eyesi Courseware**.
7. We recommend leaving the options on the right side as is.
8. To create the user, tap **Save**.
   - ▷ You are taken back to the **User Administration** screen.

2.2.2 Providing the user accounts to trainees

Provide the user accounts you have created to your trainees, for example by writing an email or by handing them out personally.

2.2.3 Trainee login

Trainees can log in to the simulator with their user account and start their first task. Please refer to the Eyesi Surgical User Guide for further information.

2.2.4 Checking your trainees' progress

The training data of all trainees is stored in a database on the simulator and can be viewed in PDF training reports. A training report is a PDF file generated by Eyesi Surgical, which can be exported to a USB flash drive. The training report contains the training history of one or multiple users.

INFO	**USB flash drive export**
All users can export their own training reports to a USB flash drive using the **Report** function of their user menu.	

Creating training reports for one or multiple user(s):

1. Connect a USB flash drive to any unused USB port of the simulator.
2. Tap the **User Training Reports** button in the main menu.
   - ▷ The **User Training Reports** screen is displayed (➲ Fig. 12 on page 15).

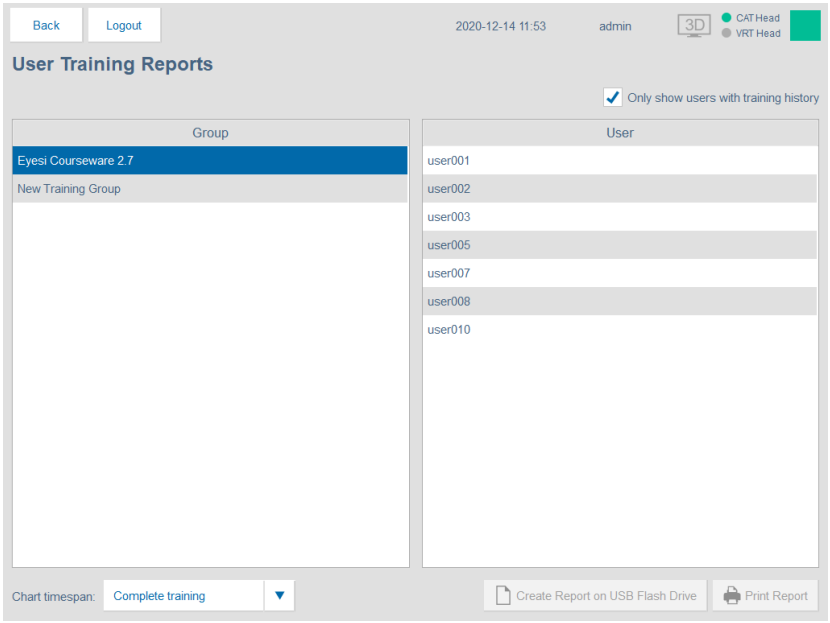


Fig. 12: User training reports screen

3. Select multiple users or only a single user.

4. Choose the training time the report shall cover from the drop-down list at the bottom of the screen.
5. To create the report, tap **Create Report on USB flash drive**.
   - A PDF file is created on the USB flash drive. A progress bar informs you about the export status.
   - The training report cannot be viewed on the simulator. Transfer the file to any regular PC to view, print, or save the reports.

3 Courseware elements

3.1 Basic skills training

Instrument handling

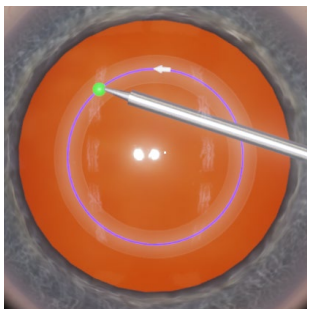
First attempts at manipulating operating instruments under an operating microscope should not be on a patient, but should be practiced safely and without additional stress. In a simulated surgical environment, Eyesi Surgical gives trainees the opportunity to become familiar with the use of microsurgical instruments and proper parameter selection for OR machine settings. They will also practice effective use of the operating microscope and illumination before they actually enter the OR.

Abstract tasks

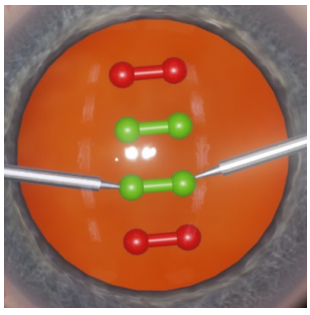
Eyesi Surgical's basic skills tasks are designed to advance the psychomotoric coordination of hand, eye and foot and spatial orientation inside the eye. The exercises aim to minimize reaction time, excess movements of the hands, and tremor. In order to train navigation in the interior of the eye and overcome the dissociation of intention and manual execution in eye-hand coordination known as the fulcrum effect, abstract exercises have proven to be equal to or even more efficient than training in a real setting.

Introductory courses

The introductory courses of the CAT-A and VRT-A tiers use abstract training scenarios to help novices gain confidence and a profound understanding of microsurgical skills essential to performing intraocular surgery safely and effectively.



Example: The introductory cataract courses (CAT-A) comprise preparatory basic skill training tasks, such as circular anti-tremor training paths, allowing novices to concentrate on their hand movement without having to interact with tissue.



Example: The Bimanual Navigation courses are designed to train using the non-dominant hand and bimanual maneuvers, as needed for lens segmentation during phaco surgery.

OR machines

Operation machines are the most sophisticated parts of technical eye surgery equipment. Both functionality and operating modes have to be fully understood. Eyesi offers physics-based simulation of OR machine functions for both phaco and vitreoretinal procedures.

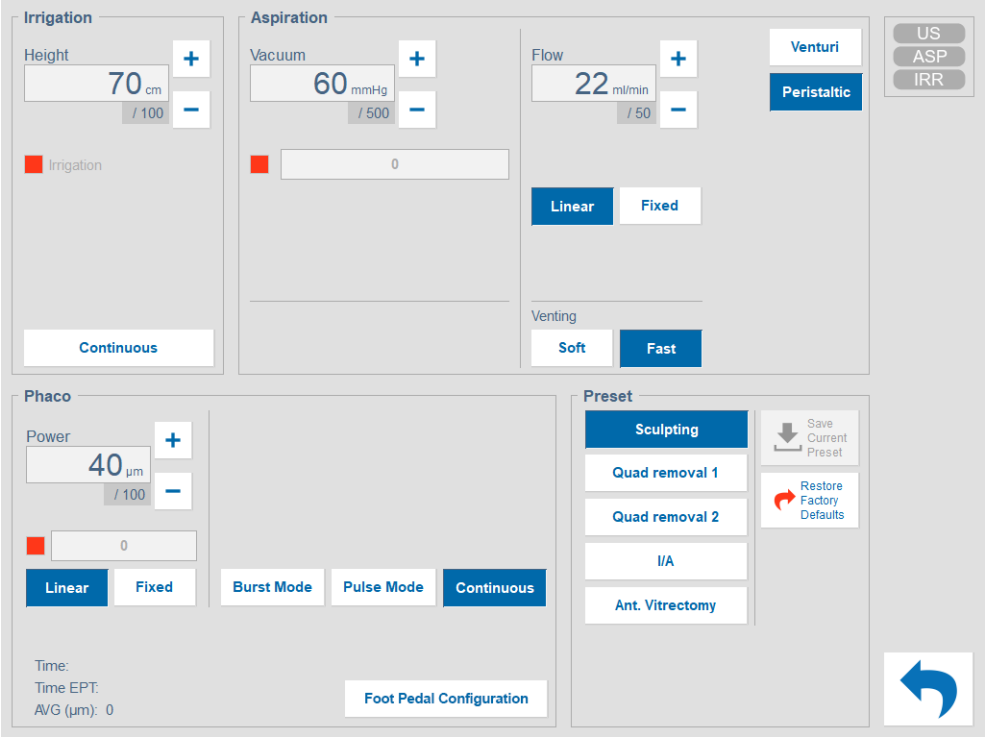
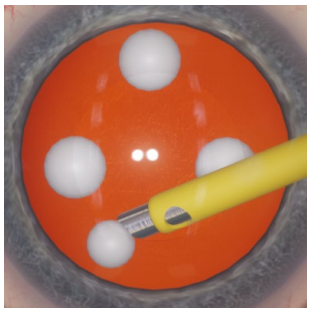


Fig. 13: OR machine with parameters for phaco procedures



Example: In the Phaco Training tasks of the cataract courses, trainees explore the settings of the phaco machine and the physical effects of changing its parameters before performing phaco divide and conquer tasks.

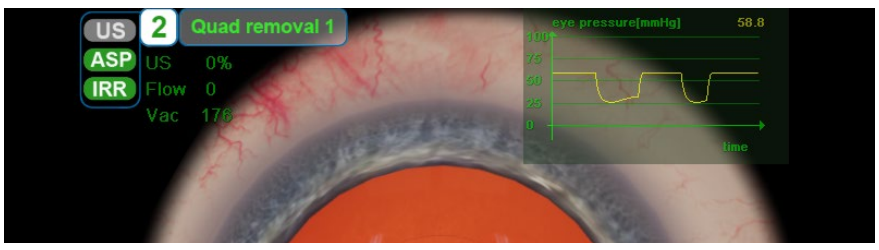
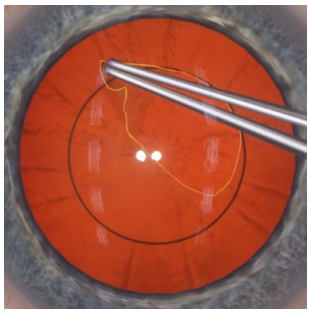


Fig. 14: In the microscope view several guiding elements are displayed to help trainees understand the principles of phaco fluidics.

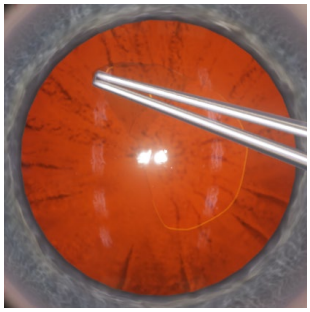
3.2 Surgical training

The beginners´ to advanced courses of Eyesi courseware provide a simulated surgical environment to practice and refine core steps of cataract and vitreoretinal surgery at increasing levels of difficulty. In the beginners´ courses, abstract basic skills training is combined with isolated steps of surgical procedures, leading to more complex tasks and multi-step-procedures in the intermediate and advanced courses. The advanced courses offer dedicated training for experienced trainees already proficient in the basic steps of surgery and needing broader exposure to scenarios which have the risk of complications.



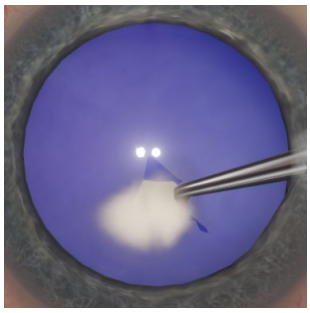
Beginners' courses

In the capsulorhexis training of the beginners´ tier (CAT-B), a well defined flap and a guiding circle is offered, so novices can focus on completing a full circular capsulorhexis. In the beginning tasks, viscoelastic is already injected.



Intermediate courses

The capsulorhexis training of CAT-C courses offers random training scenarios for injecting viscoelastic, creating an initial flap into the capsule and performing a rhexis at increasing levels of capsular tension.



Advanced courses

The advanced cataract cases of the CAT-D tier include demanding tasks, for example milky-white cataracts. Trainees have to adapt to unexpected and challenging situations, or need to deal with complications such as variations in capsular membrane tension, capsular plaques, anterior vitrectomy, or floppy iris syndrome.

3.3 Evaluation tools for students

3.3.1 Standalone and networked devices (VRmNet)

Result screen

Eyesi Surgical provides objective assessment of surgical performance and detailed skill evaluation. Various parameters relating to instrument and microscope handling, surgical efficiency and tissue treatment are recorded by the system. At the end of each task, the trainee is presented with a performance summary based on these parameters.

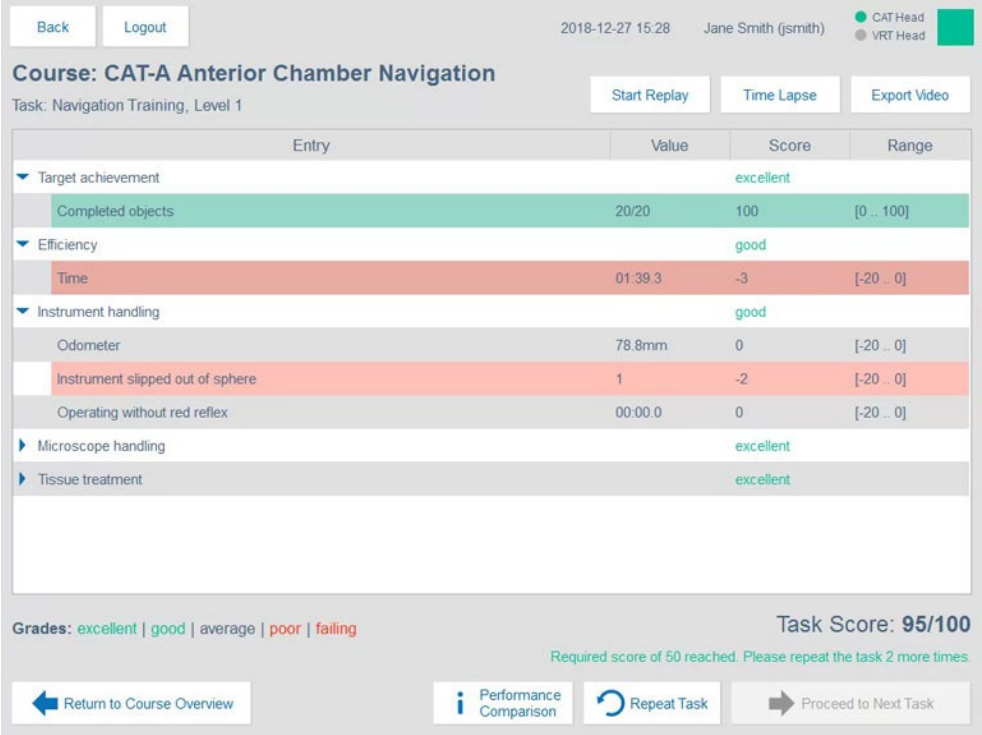


Fig. 15: Evaluation Screen

Cataract Challenge

Another tool designed to keep control of the learning process is the Cataract Challenge course, which appears the first time in tier CAT-B. The Cataract Challenge is a course trainees need to complete in regular time intervals. The course requires trainees to consecutively perform all steps of a surgical procedure in a limited time window. Since the same course has to be attempted repeatedly, this feature will help to benchmark the surgical skills development over time.

PDF training report

Trainees can export a PDF training report to a USB flash drive by tapping the **Report** button of the Eyesi Surgical user menu.

3.3.2 Networked devices with VRmNet

Performance comparison

On Eyesi Surgical simulators connected to VRmNet, a performance comparison feature ranks the individual performance in a surgical task against other users. A presentation in percentiles allows for judging the own performance at a glance. The feature promotes both better self-assessment and training motivation. The **Performance Comparison** is available on the result screen, which is displayed after finishing a simulation task.

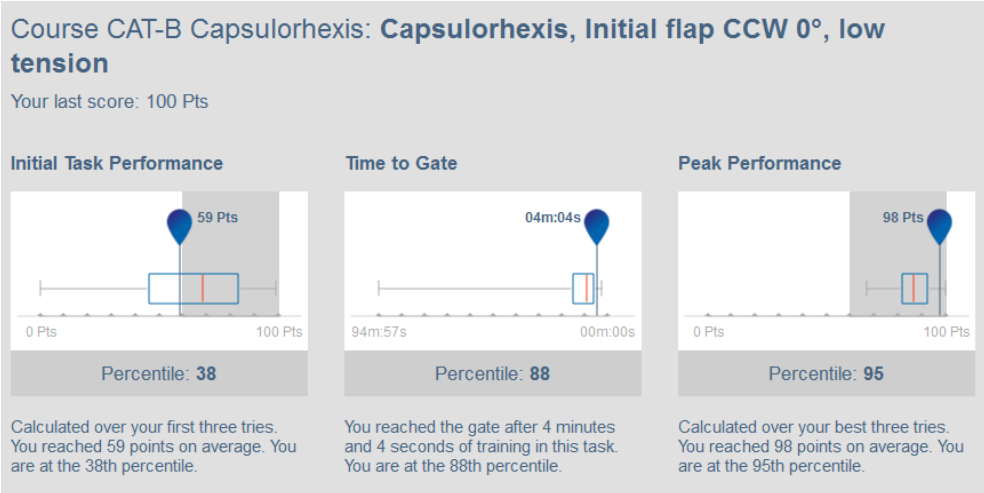


Fig. 16: Performance comparison on the Eyesi Surgical simulator

Online training statistics

On the VRmNet website, trainees have online access to their own, detailed training report, performance comparison, and a dashboard with a training overview.

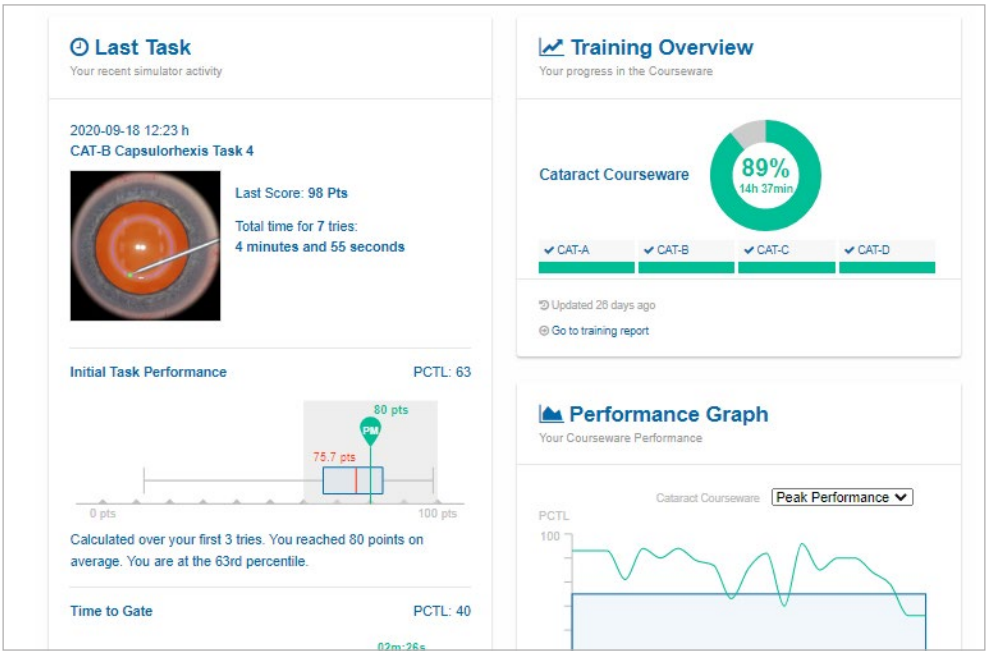


Fig. 17: Trainee dashboard on VRmNet

3.4 Online courses

INFO	VRmNet required for online courses
Online courses are only available if your simulators are connected to VRmNet.	

Content of online courses

Online courses contain background information (text, videos, images), expert interviews, and instructions related to the practical simulator courses. They are integrated into the courseware and help users to better understand what they are doing on the simulator.

Optional or mandatory

The completion of online courses is optional by default. This means that trainees do not have to view and complete the online courses to progress through the Eyesi Surgical courseware. To make the completion of online courses mandatory, please activate the corresponding checkbox while creating users (➲ section 2.1.1 on page 9) or editing users.

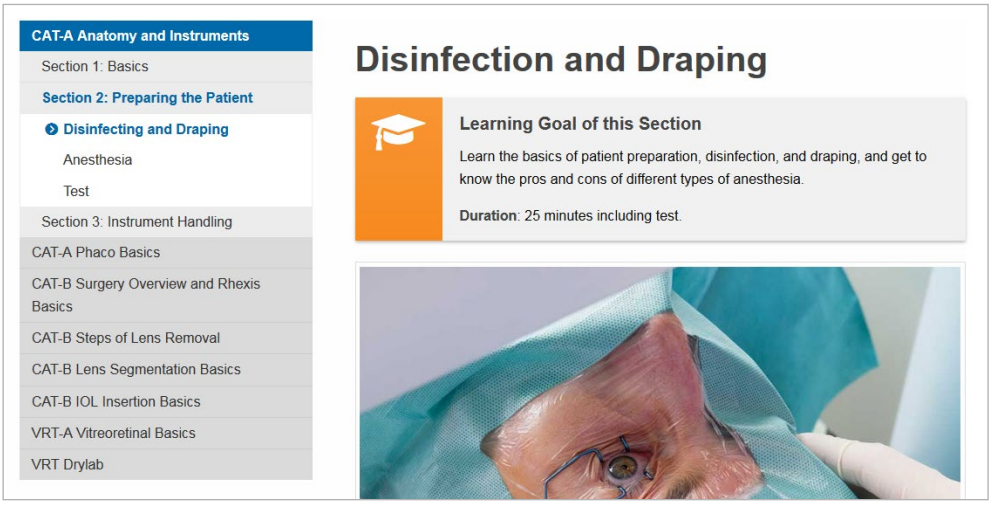


Fig. 18: Online courses on VRmNet.com

Viewing online courses

To view online courses, residents need to log in to the VRmNet website (➲ section 2 on page 8) and navigate to Online Courses > Eyesi Surgical.

Structure of online courses

Each online course consists of several sections. Each section concludes with a short multiple-choice test. To complete a section, the multiple-choice test has to be answered correctly.

Completion status of online courses

The simulator displays the completion status of the online courses in its **Training Courses** overview (➲ Fig. 19 on page 23).

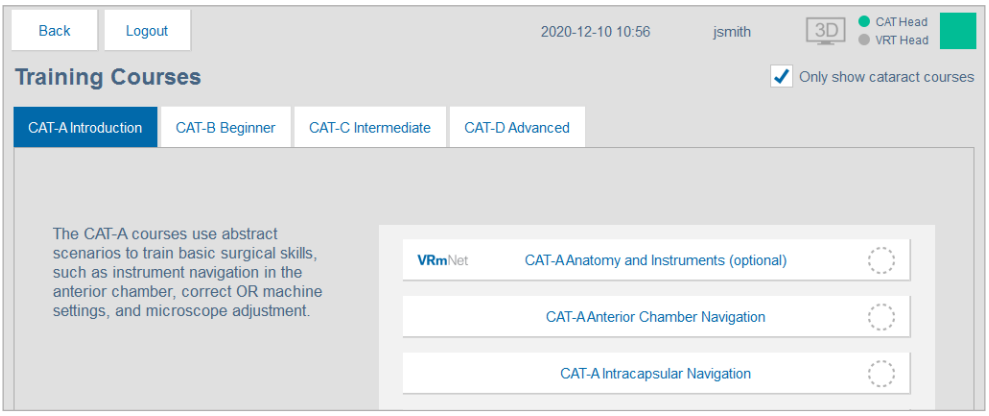


Fig. 19: Training courses overview; online courses are marked with the VRmNet logo

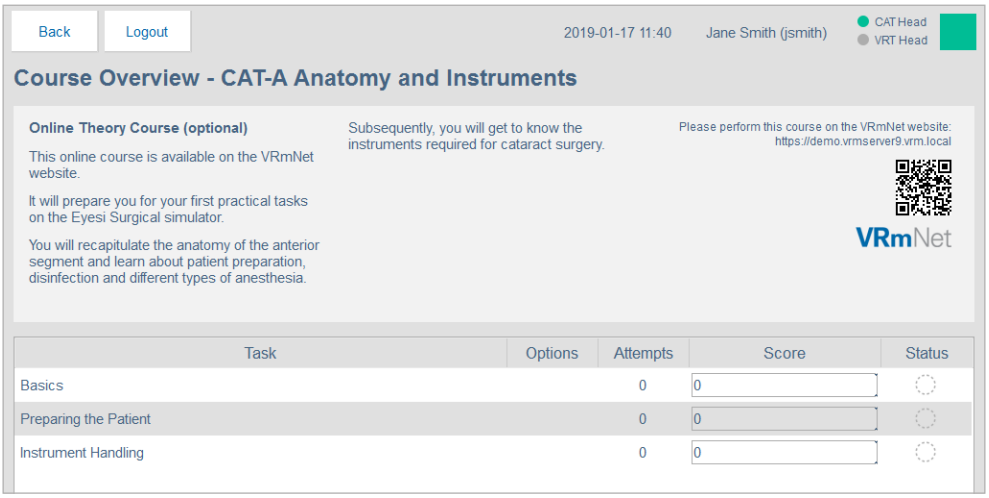


Fig. 20: Course Overview screen showing the sections of an online course

4 Cataract courseware

INFO	Online courses optional by default
The Eyesi Surgical courseware contains online courses that are available in combination with VRmNet. The online courses are optional by default, but can be set to mandatory.	

CAT-A Introductory courses

The CAT-A tier uses abstract scenarios to train basic microsurgical skills, such as instrument navigation in the anterior chamber of the eye and proper use of microscope and OR machine settings.

CAT-B Beginners´ courses

In the CAT-B tier different steps of cataract surgery will be trained separately; following abstract instrument handling tasks, trainees will practice first steps in capsulorhexis, lens segmentation, lens removal, and intraocular lens insertion in a simulated surgical environment.

CAT-C Intermediate courses

The CAT-C tier will refine trainees´ surgical skills: they will practice advanced surgery techniques before performing multi-step cataract procedures in a simulated surgical environment.

CAT-D Advanced courses

The CAT-D tier offers training of complex cataract surgery cases under demanding conditions, such as increasing capsule tensions, weak zonules, white cataracts, capsular plaques, or anterior vitrectomy.

Cataract Challenge course

After completing CAT-A, the Cataract Challenge course is unlocked. It appears in time intervals of 60 minutes regular training time. It is designed to benchmark the emerging surgical skills over time by mimicking the conditions of real surgery; trainees have to perform a complete cataract procedure in sequential order; they only have one attempt at each cataract step and a limited time window of 15 minutes.

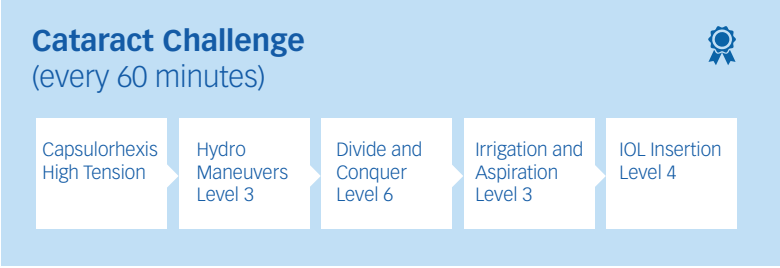


Fig. 21: Training tasks of the Cataract Challenge course

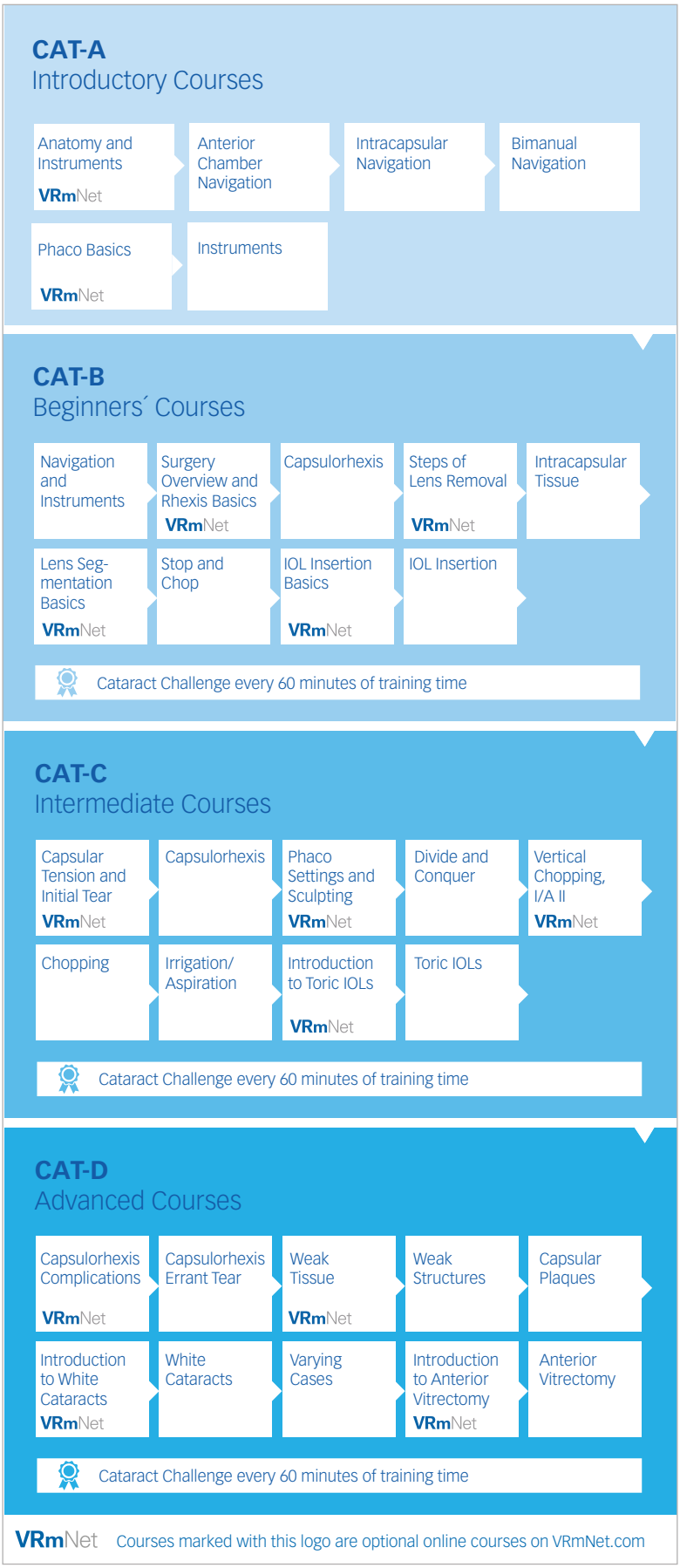


Fig. 22: Overview of the tiers and courses of the cataract courseware

4.1 CAT-A Introductory courses

The CAT-A tier uses abstract scenarios to train basic surgical skills, such as instrument navigation in the anterior chamber of the eye and proper OR machine settings. The online courses provide information on eye anatomy, patient preparation, and surgical instruments and explain how a phaco machine works.

Training objectives

- Proper microscope set-up for optimal visualization
- Spatial understanding of the anterior chamber boundaries, permitting safe movements
- Pivot movement on wound fulcrum to minimize wound stress and eye tilting
- Economy of movements within the anterior chamber
- Bimanual instrument handling
- Safe movements within the posterior capsule
- Basic understanding of the phaco machine

Courses of the CAT-A tier

- CAT-A Anatomy and Instruments (online)
- CAT-A Anterior Chamber Navigation
- CAT-A Intracapsular Navigation
- CAT-A Bimanual Navigation
- CAT-A Phaco Basics (online)
- CAT-A Instruments

Requirements for simulator courses

All simulator tasks have to be completed in **sequential order**. After a task has been completed, it may be repeated for further practice. A **required score of 50 points** must be reached with a reliability of **three times in a row** to advance to the next task of the course.

CAT-A Anatomy and Instructments (online)

This online course prepares trainees for the first practical tasks on the Eyesi Surgical simulator. Trainees recapitulate the anatomy of the anterior segment and learn about patient preparation, disinfection, and anesthesia. Further, users will get to know the instruments required for cataract surgery.

The course is optional by default (➲ section 3.4 on page 22).

Sections

- Basics (Eye Anatomy)
- Preparing the Patient (Disinfecting,Draping, Anesthesia)
- Instrument Handling (Instruments, Incisions)

CAT-A Anterior Chamber Navigation

Course description

This simulator course uses abstract tasks to train basic hand-eye coordination in the anterior chamber. Trainees will learn to perform efficient and controlled movements using a pointing instrument. In the Navigation Training tasks, the tip of the instrument has to be moved to defined targets. In the Anti-Tremor Training tasks trainees will practice to move the instrument tip along a given trajectory. Each task of this course has to be completed three times in a row. At task start, the microscope needs to be adjusted.

Required score: 50 of 100 points
Reliability gate: 3
Course options: microscope reset

Tasks

- Navigation Training Level 1
- Anti-Tremor Training Level 1
- Anti-Tremor Training Level 2
- Navigation Training Level 2
- Anti-Tremor Training Level 5
- Anti-Tremor Training Level 6

CAT-A Intracapsular Navigation

Course description

This simulator course uses abstract tasks to train controlled movements within an empty capsule where the lens has already been removed. In the Navigation Training tasks, the tip of the instrument has to be aimed at targets within the capsule. In the Anti-Tremor Training tasks, the instrument tip has to be moved along given trajectories.

Required score: 50 of 100 points
Reliability gate: 3

Tasks

- Intracapsular Navigation Training Level 1
- Intracapsular Anti-Tremor Training Level 1
- Intracapsular Anti-Tremor Training Level 2
- Intracapsular Navigation Training Level 2
- Intracapsular Anti-Tremor Training Level 3
- Intracapsular Anti-Tremor Training Level 4

CAT-A Bimanual Navigation

Course description

The CAT-A Bimanual Navigation simulator course is designed to train bimanual dexterity as needed in surgical techniques such as chopping, cracking, or bimanual I/A. Trainees will have to use two pointing instruments simultaneously to either aim at given objects or to perform opposing movements in a controlled manner.

Required score: 50 of 100 points
Reliability gate: 3

Tasks

- Bimanual Training Level 1
- Cracking & Chopping Training Level 1
- Bimanual Training Level 2
- Cracking & Chopping Training Level 2
- Bimanual Training Level 3
- Cracking & Chopping Training Level 3
- Bimanual Training Level 4
- Cracking & Chopping Training Level 4

CAT-A Phaco Basics (online)

This online course helps trainees understand how a phaco machine works, how to use the phaco foot pedal and the handpiece, and how the different settings of the operating machine influence the surgery.

The course is optional by default (➲ section 3.4 on page 22).

Sections

- The Phaco Machine (Fluidics, Pump Types, Phaco Training)

CAT-A Instruments

Course description

The CAT-A Instruments simulator course introduces use of the forceps and the phaco probe. Trainees will practice handling of the forceps by grasping and maneuvering abstract objects. Basic phaco skills, such as irrigation, aspiration and emulsification are trained on abstract objects. The phaco training tasks require an appropriate setup of the OR machine.

Required score: 50 of 100 points
Reliability gate: 3

Tasks

- Forceps Training Level 1
- Forceps Training Level 2
- Phaco Training Level 1
- Forceps Training Level 3
- Forceps Training Level 4
- Phaco Training Level 2

4.2 CAT-B Beginners' courses

In the CAT-B tier different steps of cataract surgery will be trained separately; following abstract instrument handling tasks, trainees will learn first steps in capsulorhexis, lens segmentation and lens removal in a simulated surgical environment.

Training objectives

- Effective forceps techniques for optimal tissue manipulation during the rhexis
- Deeper understanding of appropriate vector forces for the rhexis
- Effective bimanual movements for phaco chopping
- Optimizing the fluidics of the phaco probe during each step of cataract surgery
- Safe aspiration of cortex during irrigation and aspiration
- Safe use of ultrasound and aspiration during quadrant removal
- Efficient sculpting for divide and conquer technique
- Dynamic bimanual movements needed for nucleus cracking
- Correct insertion of a spheric IOL

Courses

- CAT-B Navigation and Instruments
- CAT-B Surgery Overview and Rhexis Basics (Online)
- CAT-B Capsulorhexis
- CAT-B Steps of Lens Removal (Online)
- CAT-B Intracapsular Tissue
- CAT-B Lens Segmentation Basics (Online)
- CAT-B Stop and Chop
- CAT-B IOL Insertion Basics (Online)
- CAT-B IOL Insertion

Requirements for simulator courses

All simulator tasks have to be completed in **sequential order**. The microscope needs to be set up at the start. It maintains its focus and zoom between tasks. A **required score of 60 points** must be reached with a reliability of **three times in a row** to advance to the next task of the course. After a task has been completed, it may be repeated for further practice.

In intervals of 60 minutes training time, trainees will be asked to attempt the **Cataract Challenge** course. The challenge course requires trainees to complete all steps of cataract surgery in a limited time window of 15 minutes. There are no required scores, no second attempts at any task, and a continuously running clock.

CAT-B Navigation and Instruments

Course description

The CAT-B Navigation and Instruments simulator course repeats training of basic instrument skills in abstract scenarios as already introduced in the CAT-A courses. Trainees will refine their instrument movements as well as the handling of forceps and phaco instrument.

Required score: 60 of 100 points
Reliability gate: 3

Tasks

- Navigation Training Level 3
- Intracapsular Navigation Training Level 3
- Anti-Tremor Training Level 7
- Forceps Training Level 4
- Intracapsular Anti-Tremor Training Level 5
- Bimanual Training Level 5
- Cracking & Chopping Training Level 5
- Phaco Training Level 3

CAT-B Surgery Overview and Rhexis Basics (online)

Course description

This online course provides an overview of the steps of cataract surgery with real surgery videos. Subsequently, trainees will get familiar with the basics of creating a continuous curvilinear capsulorhexis and the required instruments.

The course is optional by default (➲ section 3.4 on page 22).

Sections

- Cataract Surgery Steps (overview from biometry to IOL insertion)
- Rhexis Basics (techniques, instruments, optimal size and shape)

CAT-B Capsulorhexis

Course description

The CAT-B Capsulorhexis simulator course trains the circular opening of the anterior capsule. Abstract tasks are combined with surgical tasks at increasing levels of capsule tension. Trainees will start practicing circular movements in clockwise (CW) or counterclockwise (CCW) direction and then create a corresponding rhexis. An initial tear will be offered at varying positions. The anterior chamber is permanently filled with viscoelastic, so no viscoelastic fluid has to be injected in this course. Throughout the course, the visibility of the rhexis is enhanced compared to the real surgical situation.

Required score: 60 of 100 points
Reliability gate: 3

Tasks

- Anti-Tremor Training Level 3
- Capsulorhexis, Initial Flap CCW 0°, Low Tension
- Capsulorhexis, Initial Flap CCW 90°, Low Tension
- Anti-Tremor Training Level 4
- Capsulorhexis, Initial Flap CW 0°, Low Tension
- Capsulorhexis, Initial Flap CW 90°, Low Tension
- Capsulorhexis, Initial Flap CCW 180°, Med Tension
- Capsulorhexis, Initial Flap CCW 270°, Med Tension
- Capsulorhexis, Initial Flap CW 0°, Med Tension
- Capsulorhexis, Initial Flap CW 270°, Med Tension

CAT-B Steps of Lens Removal (online)

Course description

This online course provides a short aside on cataract pathophysiology before introducing trainees to the techniques required to remove the lens from the capsule bag: hydrodissection and hydrodelineation, phaco divide and conquer, and irrigation and aspiration.

The course is optional by default (➲ section 3.4 on page 22).

Sections

- Hydro Techniques (hydrodissection and hydrodelineation)
- Divide and Conquer (instruments, phaco settings, instructions)
- Irrigation and Aspiration (instruments, phaco settings, instructions)

CAT-B Intracapsular Tissue

Course description

This simulator course is designed to introduce essential skills needed in phaco surgery; hydrodissection and hydrodelineation as well as removal of the lens and residual cortex. The Hydro Maneuvers tasks train separation of the lens nucleus from the cortex and the capsule as well as separation of the epinucleus from the harder inner nucleus. In the Divide and Conquer tasks, lens parts have to be removed using the phaco instrument. The Irrigation-and-Aspiration tasks train the removal of residual cortex after lens removal. Different OR machine settings can be explored.

Required score: 60 of 100 points
Reliability gate: 3

Tasks

- Hydro Maneuvers Level 1 (very soft lens, light attachment)
- Phaco Divide and Conquer Level 1 (one lens quarter)
- Irrigation and Aspiration Level 1 (one quarter)
- Hydro Maneuvers Level 2 (soft lens, slightly increased attachment)
- Phaco Divide and Conquer Level 2 (four lens quarters)
- Irrigation and Aspiration Level 2 (three quarters)

CAT-B Lens Segmentation Basics (online)

Course description

In this online course, trainees will learn about two alternative lens segmentation approaches: cracking and chopping. Further, the stop and chop procedure with horizontal chop is explained.

The course is optional by default (➲ section 3.4 on page 22).

Sections

- Cracking (instruments, lens rotation, cracking technique)
- Chopping (horizontal chop, stop and chop technique)

CAT-B Stop And Chop

Course description

This simulator course teaches skills needed for applying the Stop and Chop technique for nuclear segmentation and removal. Trainees will begin by carving a central groove into the lens using the phaco instrument and then splitting the nucleus into two halves. Subsequently, the lens halves have to be aspirated with the phaco tip and then chopped into quadrants using the horizontal chopper. Each step of the Stop and Chop procedure is trained in separate tasks.

Required score: 60 of 100 points
Reliability gate: 3

Tasks

- Phaco Divide and Conquer Level 3 (sculpting performed, crack into two halves)
- Phaco Chopping Training Level 1 (half nucleus, horizontal chopper)
- Phaco Divide and Conquer Level 8 (sculpt and crack into two halves)
- Phaco Chopping Training Level 2 (two half nuclei, horizontal chopper)

CAT-B IOL Insertion Basics (online)

Course description

In this online course, trainees will become familiar with different ophthalmic visco-surgical devices (also called viscoelastics). Subsequently, trainees will be introduced to the most common types of intraocular lenses (IOLs) and the basic IOL insertion technique.

The course is optional by default (➲ section 3.4 on page 22).

Sections

- Viscoelastics (properties, types, and usage)
- IOL Types (designs, materials, optic properties)
- Insertion Procedure (IOL orientation, insertion procedure)

CAT-B IOL Insertion

Course description

The IOL Insertion simulator course trains the procedure of inserting a spheric intra-ocular lens (IOL) into an empty capsule bag. In the first task, a spheric IOL is already inserted and only the viscoelastic has to be removed. The second task trains the full procedure: after injecting viscoelastic into the capsule, trainees have to inject the IOL. Finally, the viscoelastic has to be removed again. In the last task, the position of a misplaced IOL has to be corrected.

Required score: 60 of 100 points
Reliability gate: 3

Tasks

- IOL Insertion Level 1 (spheric IOL inserted, remove viscoelastic)
- IOL Insertion Level 3 (insert spheric IOL)
- IOL Insertion Level 7 (correct misplaced spheric IOL)

4.3 CAT-C Intermediate courses

The CAT-C tier refines already acquired cataract skills through more challenging scenarios: trainees practice advanced surgery techniques before performing multi-step cataract procedures.

Training objectives

- Effective use of cystotome and forceps for flap construction
- Proper use of viscoelastic fluid to preserve chamber depth and flap stability during the rhexis
- Rhexis techniques on high tension capsules
- Hydrodissection technique for dense nucleus
- Complete I&A step using straight or bent tip for either coaxial or bimanual irrigation and aspiration
- Complete phaco divide and conquer procedure with sculpting, cracking, quadrant removal
- Stop-and-chop technique
- Horizontal chopping principals
- Correct insertion of a toric IOL

Courses

- CAT-C Capsular Tension and Initial Tear (Online)
- CAT-C Capsulorhexis
- CAT-C Phaco Settings and Sculpting (Online)
- CAT-C Divide and Conquer
- CAT-C Vertical Chopping, I/A II (Online)
- CAT-C Chopping
- CAT-C Irrigation/Aspiration
- CAT-C Introduction to Toric IOLs (Online)
- CAT-C Toric IOLs

Requirements for simulator courses

All simulator tasks have to be completed in **sequential order**. The microscope needs to be set up at the start. It maintains its focus and zoom between tasks. A **required score of 70 points** must be reached with a reliability of **three times in a row** to advance to the next task of the course. After a task has been completed, it may be repeated for further practice.

In intervals of 60 minutes training time, trainees will be asked to attempt the **Cataract Challenge** course. The challenge course requires trainees to complete all steps of cataract surgery in a limited time window of 15 minutes. There are no required scores, no second attempts at any task, and a continuously running clock.

CAT-C Capsular Tension and Initial Tear (online)

Course description

This online course explains the characteristics of the capsular tissue, the effects of capsular tension on the rhexis, the role that ophthalmic viscosurgical devices play during capsulorhexis, and the creation of the initial tear in the capsulorhexis procedure.

The course is optional by default (➲ section 3.4 on page 22).

Sections

- Capsule Tissue
- Capsular Tension and Viscoelastics
- Initial Tear Construction

CAT-C Capsulorhexis

Course description

The CAT-C Capsulorhexis simulator course is designed to enhance the acquired basic capsulorhexis skills. Trainees will practice to tear an initial flap into the capsule. The rhexis then has to be performed on capsules with increasing tension, which makes the capsule more sensitive. The same capsulorhexis task first has to be performed with a guiding circle and then without one. The course starts with an increased visibility of the capsule. During the course, however, visibility will be reduced to a realistic level.

Required score: 70 of 100 points
Reliability gate: 3

Tasks

- Capsulorhexis, Low tension with guiding elements
- Capsulorhexis, Low tension without guiding elements
- Capsulorhexis, Med tension with guiding elements
- Capsulorhexis, Med tension without guiding elements
- Capsulorhexis, High tension with guiding elements
- Capsulorhexis, High tension without guiding elements

CAT-C Phaco Settings and Sculpting (online)

Course description

The second online course of CAT-C focuses on the phaco handpiece and the different ways to configure the phaco machine for specific purposes. Further, the course explains techniques for sculpting and lens removal in detail before providing tips on avoiding and managing a posterior capsule rupture.

The course is optional by default (➲ section 3.4 on page 22).

Sections

- Phaco Power
- Sculpting
- Lens Removal
- Posterior Capsule Rupture

CAT-C Divide and Conquer

Course description

This simulator course fosters an advanced understanding of nuclear segmentation using the divide and conquer technique. First, trainees will mobilize the lens by performing hydrodissection and hydrodelineation. After cracking a pre-sculpted lens, trainees will then have to perform the complete divide and conquer procedure including sculpting, cracking and lens removal on a soft and a medium hard lens.

Required score: 70 of 100 points
Reliability gate: 3

Tasks

- Hydro Maneuvers Level 3
- Phaco Divide and Conquer Level 4
- Hydro Maneuvers Level 6
- Phaco Divide and Conquer Level 5
- Phaco Divide and Conquer Level 6

CAT-C Vertical Chopping, I/A II (online)

Course description

This online course introduces the vertical chopping technique and compares the different lens segmentation techniques with each other. In a second section, the course dives deeper into advanced irrigation and aspiration strategies.

The course is optional by default (➲ section 3.4 on page 22).

Sections

- Vertical Chopping
- Irrigation and Aspiration

CAT-C Chopping

Course description

The CAT-C Chopping simulator course aims at practicing bimanual instrument movements and chopping techniques as needed for lens removal. In the abstract Cracking & Chopping Training tasks trainees will practice the bimanual instrument movements required for lens cracking and handling lens segments. The horizontal and vertical chopping techniques are trained in the Phaco Chopping Training tasks; trainees have to stabilize the lens with the phaco instrument and at the same time chop it into smaller pieces using a horizontal or vertical chopper.

Required score: 70 of 100 points
Reliability gate: 3

Tasks

- Cracking & Chopping Training Level 5
- Phaco Chopping Training Level 3 (full nucleus, horizontal chopper)
- Cracking & Chopping Training Level 6
- Phaco Chopping Training Level 4 (half nucleus, vertical chopper)
- Cracking & Chopping Training Level 8
- Phaco Chopping Training Level 5 (two half nuclei, vertical chopper)
- Phaco Chopping Training Level 6 (full nucleus, vertical chopper)

CAT-C Irrigation/Aspiration

Course description

This simulator course trains the removal of residual cortex while avoiding a capsular rupture caused by exerting stress to capsule and zonular fibers. The Intracapsular Anti-Tremor task is intended to prepare trainees for capsule polishing. The Intracapsular Navigation Training task trains instrument handling in the sub-anterior capsular region, especially with J-shaped instruments. In the Irrigation and Aspiration tasks trainees can explore the use of adequate vacuum and flow values for removing residual cortex.

Required score: 70 of 100 points
Reliability gate: 3

Tasks

- Intracapsular Anti-Tremor Training Level 3
- Irrigation and Aspiration Level 3
- Intracapsular Navigation Training Level 3
- Irrigation and Aspiration Level 4

CAT-C Introduction to Toric IOLs (online)

Course description

The last online course of CAT-C teaches the fundamentals of astigmatism and the use of toric intraocular lenses to correct it. Trainees learn essential toric intraocular lens implantation steps and how to achieve the correct IOL orientation in the capsule bag.

The course is optional by default (➲ section 3.4 on page 22).

Sections

- Astigmatism
- Implantation

CAT-C Toric IOLs

Course description

The Toric IOLs simulator course trains the procedure of inserting a toric IOL. In the first task, a toric IOL is already inserted and only the viscoelastic has to be removed. The second task trains the full procedure: after injecting viscoelastic into the capsule, trainees have to inject the IOL. After rotating the IOL in its correct position, the viscoelastic has to be removed again and the position and orientation of the IOL has to be checked. In the last task, the position of a misplaced toric IOL has to be corrected.

Required score: 70 of 100 points
Reliability gate: 3

Tasks

- IOL Insertion Level 2 (toric IOL inserted, remove viscoelastic)
- IOL Insertion Level 4 (insert toric IOL)
- IOL Insertion Level 8 (correct misplaced toric IOL)

4.4 CAT-D Advanced courses

The CAT-D tier offers training of complex cataract surgery cases under demanding conditions, such as increasing capsule tensions and weak zonules and complications. In the courses trainees will be challenged by randomized tasks and complications, requiring them to quickly adapt to the surgical scenario.

Courses

- CAT-D Capsulorhexis Complications (online)
- CAT-D Capsulorhexis Errant Tear
- CAT-D Weak Tissue (online)
- CAT-D Weak Structures
- CAT-D Capsular Plaques
- CAT-D Introduction to White Cataracts (online)
- CAT-D White Cataracts
- CAT-D Varying Cases
- CAT-D Introduction to Anterior Vitrectomy (online)
- CAT-D Anterior Vitrectomy

Requirements for simulator courses

All simulator tasks have to be completed in **sequential order**. The microscope needs to be set up at the start. It maintains its focus and zoom between tasks. A **required score of 80 points** must be reached with a reliability of **three times in a row** to advance to the next task of the course. After a task has been completed, it may be repeated for further practice.

In intervals of 60 minutes training time, trainees will be asked to attempt the **Cataract Challenge** course. The challenge course requires trainees to complete all steps of cataract surgery in a limited time window of 15 minutes. There are no required scores, no second attempts at any task, and a continuously running clock.

CAT-D Capsulorhexis Complications (online)

Course description

Even if taking precautionary measures, there is the possibility of having a capsular tear that runs peripherally towards the equator. This online course describes risk factors for tear-outs, teaches how to avoid and detect them, and how to rescue the capsulorhexis if a tear-out has happened.

The course is optional by default (➲ section 3.4 on page 22).

Sections

- Tear-Out

CAT-D Capsulorhexis Errant Tear

Course description

The CAT-D Capsulorhexis Errant Tear simulator course refines the technique of creating a clockwise (CW) or counterclockwise (CCW) rhexis under increasingly difficult conditions; the capsule tension is medium to high, and the tear tends to run outwards. In all tasks, viscoelastic has to be injected before opening the anterior capsule. An initial tear has been created and a guiding circle is displayed.

Required score: 80 of 100 points
Reliability gate: 3

Tasks

- Capsulorhexis: Errant tear (CCW), medium tension
- Capsulorhexis: Errant Tear (CW), medium tension
- Capsulorhexis: Errant Tear (CCW), high tension
- Capsulorhexis: Errant Tear (CW), high tension
- Capsulorhexis: Errant Tear (CCW), high tension, without guiding elements
- Capsulorhexis: Errant Tear (CW), high tension, without guiding elements

CAT-D Weak Tissue (online)

Course description

Weak or compromised intraocular tissue makes cataract surgery more demanding. To prepare trainees for difficult situations, this course deals with weak zonular fibers and implantation of capsular tension rings, intraoperative floppy iris syndrome and insertion of iris expansion rings, as well as capsular plaques.

The course is optional by default (➲ section 3.4 on page 22).

Sections

- Weak Zonular Fibers
- Surgical Management of Zonulopathy
- Floppy Iris Syndrome
- Anterior Capsular Plaques

CAT-D Weak Structures

Course description

In this simulator course trainees practice challenging surgical tasks on patients with weak zonules, high capsular tension, or intraoperative floppy iris syndrome.

The Iris Expansion Ring tasks deal with the floppy iris syndrome, where it is not possible to widen the iris with medication sufficiently. Practice inserting and removing an iris expansion ring, which mechanically expands the pupil.

In the Capsulorhexis tasks, you will encounter high capsular tension and weak zonules while creating a clockwise (CW) and counter-clockwise (CCW) rhexis. Both factors make the tear hard to control and increase the risk of a peripheral tear-out. Keep the rhexis stable using the Brian Little rescue technique whenever necessary.

In the Hydro Maneuvers task, inject carefully and ensure that the injected fluid can escape from under the lens to avoid rupturing the weak capsule.

In the Capsular Tension Ring (CTR) tasks, you will practice CTR insertion and the following delicate I/A procedure. You will also have the opportunity to correct the position of misplaced CTRs. Inserting a capsular tension ring (CTR) is indicated to stabilize the capsular bag in the presence of weakened zonules.

Required score: 80 of 100 points
Reliability gate: 3

Tasks

- Iris Expansion Ring Level 1
- Iris Expansion Ring Level 2
- Capsulorhexis: weak zonules, high tension, errant tear (CCW)
- Capsulorhexis: weak zonules, high tension, errant tear (CW)
- Hydro Maneuvers Level 8
- Capsular Tension Ring, Level 2
- Capsular Tension Ring, Level 3
- Capsular Tension Ring, Level 4

CAT-D Capsular Plaques

Course description

This simulator course focuses on anterior capsule plaques of varying size and location. Depending on the plaque position trainees have to decide whether to tear around the plaque or tear through the plaque. Leading the capsulorhexis through a plaque requires great care because of the different tear behavior. In many tasks high capsular tension and weak zonules increase the danger of capsular damage.

Required score: 80 of 100 points
Reliability gate: 3

Tasks

- Capsulorhexis: small plaques, defined location, medium capsular tension
- Capsulorhexis: medium plaques, defined location, high capsular tension

CAT-D Introduction to White Cataracts (online)

Course description

White cataracts pose a higher degree of difficulty to all surgeons and require additional surgical steps. This online course prepares trainees for the following simulator course by providing background information on white cataracts and instructions on dealing with them.

The course is optional by default (➲ section 3.4 on page 22).

Sections

- Introduction
- Surgical Management

CAT-D White Cataracts

Course description

This simulator course practices the steps and precautions needed when dealing with white cataracts. Trainees have to stain the capsule with blue dye to facilitate visibility of the rhexis in the absence of a red reflex. Then, generous injection of viscoelastic is necessary to increase anterior chamber pressure, which counteracts the high intracapsular pressure and prevents an uncontrollable capsule tear when opening the capsule bag (Argentinian flag sign). In the last task, trainees have to deal with a milky-white cataract where liquefied cortex enters the anterior chamber. The course is supplemented by a hydro maneuvers task, where hydrodissection has to be performed on a white lens.

Required score: 80 of 100 points
Reliability gate: 3

Tasks

- Capsulorhexis: white cataract, low capsular tension
- Capsulorhexis: white cataract, high capsular tension, weak zonules
- Hydro Maneuvers Level 7
- Capsulorhexis: milky-white cataract, high capsular tension

CAT-D Varying Cases

Course description

The difficulty of this simulator course is that the conditions under which the tasks have to be performed vary randomly and unpredictably. In the capsulorhexis tasks, capsular tension may be low, medium, or high, the zonules might be intact or weak, and other complications may occur. In the Hydro Maneuvers tasks, the adherence of the nucleus to the capsule cortex varies randomly. The aim of this course is to prepare trainees for surprises in real patient cases and to further improve their skills.

Required score: 80 of 100 points
Reliability gate: 5

Tasks

- Capsulorhexis: varying situations, no guidance
- Hydro Maneuvers Level 10: varying situations
- Capsulorhexis plaques: varying situations with high capsular tension (variation in location, size, zonular strength)

CAT-D Introduction to Anterior Vitrectomy (online)

Course description

A posterior capsular rupture is most likely to occur during capsulorhexis, phaco-emulsification, or cortex removal. Its main consequence is vitreous protrusion into the anterior chamber. This last online course of CAT-D teaches using the vitrector instrument in the anterior segment to remove the vitreous and stabilize the eye for IOL insertion.

The course is optional by default (➲ section 3.4 on page 22).

Sections

- Introduction
- The vitrector instrument
- Surgical procedure

CAT-D Anterior Vitrectomy

Course description

This simulator course practices anterior vitrectomy, a mostly unplanned event in cataract surgery, where vitreous prolapses into the anterior segment after a capsular rupture. This may happen, for example, during irrigation and aspiration. The gel-like vitreous occludes the aspiration tip, resulting in zero flow. The vitreous needs to be removed from the anterior segment using the vitrector before irrigation and aspiration can be continued.

The tasks in this course vary in difficulty and number of necessary steps. In the easiest task, only the vitreous need to be removed. More complicated tasks start and end with the I/A procedure, require staining of the vitreous, have larger amounts of vitreous prolapsing into the capsule, or have vitreous sticking to structures of the anterior chamber.

Required score: 80 of 100 points
Reliability gate: 3

Tasks

- Anterior Vitrectomy Level 7
- Anterior Vitrectomy Level 1
- Anterior Vitrectomy Level 4
- Anterior Vitrectomy Level 2
- Anterior Vitrectomy Level 3
- Anterior Vitrectomy Level 5
- Anterior Vitrectomy Level 6

5 Vitreoretinal courseware

VRT-A Introductory courses

The VRT-A tier uses abstract scenarios to train basic surgical skills, such as instrument navigation in the vitreous and proper OR machine settings. Trainees will also learn to visualize the vitreous through efficient use of microscope and light source.

VRT-B Beginners´ courses

In the VRT-B tier different steps of vitreoretinal surgery will be trained separately; following abstract instrument handling tasks, trainees will practice first steps in peeling and removing membranes in a simulated surgical environment.

VRT-C Advanced courses

The advanced VRT-C tier refines already acquired surgery skills by training multi-step vitreoretinal procedures under increasingly demanding conditions, such as treatment of retinal detachment.

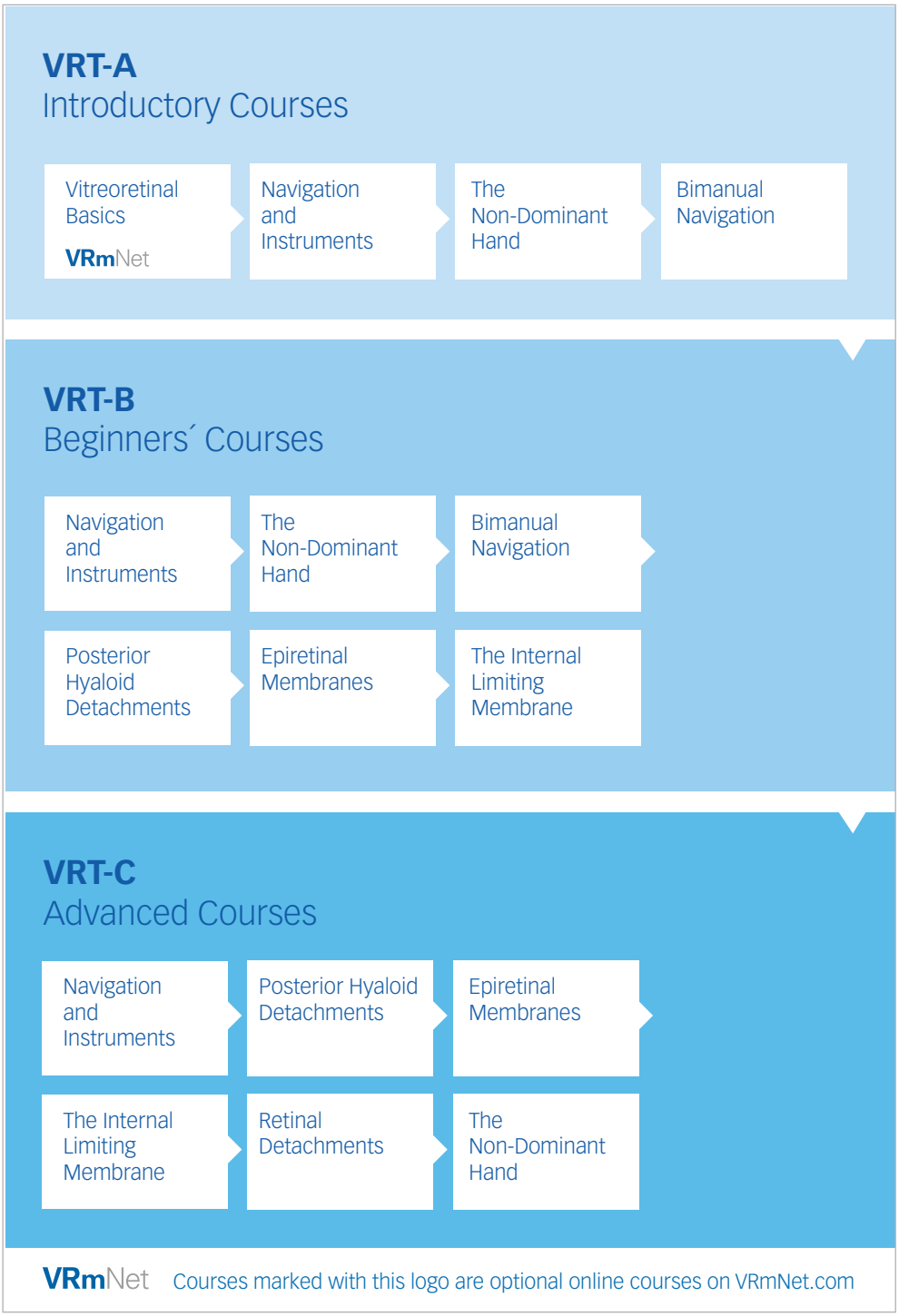


Fig. 23: Overview of the tiers and courses of the vitreoretinal courseware

5.1 VRT-A Introductory courses

The VRT-A tier uses abstract scenarios to train basic surgical skills, such as instrument navigation in the vitreous and proper OR machine settings. Trainees will also learn to visualize the vitreous through efficient use of microscope and light source.

Training objectives

- Proper set up of non-contact viewing system for optimal visualization and wide field view
- Fluid use of microscope X/Y functions to center the surgical field in the field of view
- Appropriate illumination for depth of field and visualization of tissue details
- Spatial understanding of the vitreous space for safe instrument movements out to the equator and beyond
- Tactical and discrete tilting of the eye with instrument pressure to view the periphery
- Improved instrument handling with forceps and scissors
- Improved dexterity of the non-dominant hand

Courses

- VRT-A Vitreoretinal Basics (Online)
- VRT-A Navigation And Instruments
- VRT-A The Non-Dominant Hand
- VRT-A Bimanual Navigation

Requirements for simulator courses

All simulator tasks have to be completed in **sequential order**. A **required score of 40 points** must be reached with a reliability of **three times in a row** to advance to the next task of the course. After a task has been completed, it may be repeated for further practice.

VRT-A Vitreoretinal Basics (online)

Course description

This online course prepares trainees for your vitreoretinal training. Users are introduced to the simulator hardware for vitreoretinal training, and learn some basics on posterior segment surgery.

The course is optional by default (➲ section 3.4 on page 22).

Sections

- Introduction (vitreoretinal optics, pitfalls, simulator hardware)

VRT-A Navigation and Instruments

Course description

The VRT-A Navigation and Instruments simulator course uses abstract tasks to train basic hand-eye coordination in the vitreous. Trainees will learn to perform efficient and accurate movements using different instruments and a light source, without touching the retina or the back of the lens. In the Navigation Training tasks, the tip of a pointing instrument has to be moved to defined targets. Trainees will practice handling of the forceps by grasping and maneuvering abstract objects in the Forceps Training tasks. In the Anti-Tremor Training tasks they will train moving the instrument tip along a given trajectory.

Required score: 40 of 100 points
Reliability gate: 3

Tasks

- Navigation Training Level 1
- Forceps Training Level 4
- Anti-Tremor Training Level 2
- Navigation Training Level 2
- Forceps Training Level 2
- Anti-Tremor Training Level 1

VRT-A The Non-Dominant Hand

Course description

This simulator course trains efficient and accurate instrument movements using the non-dominant hand. While holding the light source with their dominant hand, trainees will have to use their non-dominant hand to move a pointing instrument to defined targets or along a given trajectory. In the Forceps Training trainees will have to grasp abstract objects. By the way: non-dominant hand based maneuvers often occur during surgery when a delicate structure is hard to reach by the dominant hand, e.g. because it is situated close to an incision. A successful completion of the non-dominant hand courses will let trainees cope with such a situation with flexibility and ease.

Required score: 40 of 100 points
Reliability gate: 3
Options: non-dominant hand usage

Tasks

- Navigation Training ND Level 1
- Forceps Training ND Level 4
- Anti-Tremor Training ND Level 2
- Navigation Training ND Level 2
- Forceps Training ND Level 2
- Anti-Tremor Training ND Level 1

VRT-A Bimanual Navigation

Course description

This simulator course is designed to train bimanual dexterity as well as working close to the retina. Illumination is provided by a single chandelier lighting system. Instrument shadows therefore are less distinctive, making navigation more demanding. In the Bimanual Training tasks, trainees will have to aim two pointing instruments at given targets simultaneously. In the Bimanual Scissors Training tasks, abstract objects which adhere to the retina have to be grasped with an aspirator and at the same time cut off as close to the retina as possible using the scissors.

Required score: 40 of 100 points
Reliability gate: 3

Tasks

- Bimanual Training Level 1
- Bimanual Scissors Training Level 1
- Bimanual Training Level 2
- Bimanual Scissors Training Level 2

5.2 VRT-B Beginners' courses

In the VRT-B tier different steps of vitreoretinal surgery will be trained separately; following abstract instrument handling tasks, trainees will practice first steps in peeling and removing membranes in a simulated surgical environment.

Training objectives

- Proper settings for vitrectomy fluidics, for appropriate cutting rates, infusion, and aspiration levels
- Vitrectomy hand piece manipulation for effective tissue cutting and aspiration
- Use of scleral indentation for working in the periphery
- Laser probe manipulation for effective tissue adhesion with minimal burning of healthy retina and/or sensitive structures
- Improved bimanual dexterity as needed in complex tasks
- Safely grasping and peeling membranes with low to moderate adherence.

Courses

- VRT-B Navigation and Instruments
- VRT-B The Non-Dominant Hand
- VRT-B Bimanual Navigation
- VRT-B Posterior Hyaloid Detachments
- VRT-B Epiretinal Membranes
- VRT-B The Internal Limiting Membrane

Requirements for simulator courses

All simulator tasks have to be completed in **sequential order**. The microscope needs to be set up at the start. It maintains its focus and zoom between tasks. A **required score of 60 points** must be reached with a reliability of **three times in a row** to advance to the next task of the course. After a task has been completed, it may be repeated for further practice.

VRT-B Navigation and Instruments

Course description

The VRT-B Navigation and Instruments simulator course repeats training of basic instrument skills in abstract scenarios as already introduced in the VRT-A courses; trainees will improve handling of the pointing instrument and the forceps. In addition, the laser instrument is introduced in the Laser Coagulation tasks; small retinal tears have to be fixed and, in another task, the whole retina has to be lasered (panretinal photocoagulation).

Required score: 60 of 100 points
Reliability gate: 3

Tasks

- Laser Coagulation Level 2
- Navigation Training Level 3
- Forceps Training Level 1
- Anti-Tremor Training Level 3
- Laser Coagulation Level 6 (panretinal)

VRT-B The Non-Dominant Hand

Course description

The instrument handling tasks of this simulator course have to be accomplished using the non-dominant hand while the dominant hand holds the light source. In abstract scenarios trainees will use the laser to accurately hit targets on the retina, or grasp and handle objects with the forceps. Trainees will also use the pointing instrument and move it to defined targets or along a given trajectory.

Required score: 60 of 100 points
Reliability gate: 3
Options: non-dominant hand usage

Tasks

- Laser Coagulation ND Level 2
- Navigation Training ND Level 3
- Forceps Training ND Level 1
- Anti-Tremor Training ND Level 3

VRT-B Bimanual Navigation

Course description

The VRT-B Bimanual Navigation simulator course offers further training of bimanual techniques and the use of scissors as needed for membrane peeling. In the Bimanual Training tasks, trainees will have to aim two pointing instruments at relatively small targets simultaneously. In the Bimanual Scissors Training tasks, an object adhering close to the retina has to be grasped and cut off.

Required score: 60 of 100 points
Reliability gate: 3

Tasks

- Bimanual Training Level 3
- Bimanual Scissors Training Level 3
- Bimanual Training Level 4
- Bimanual Scissors Training Level 4

VRT-B Posterior Hyaloid Detachments

Course description

This simulator course introduces the vitrector and lets trainees explore different OR machine settings of vacuum and cut rate. In the Posterior Hyaloid tasks trainees will remove a stained or unstained posterior hyaloid, which is either already detached or still adheres moderately to the retina. Accurate movements very close to the retina are trained in the Navigation Training task.

Required score: 60 of 100 points
Reliability gate: 3

Tasks

- Posterior Hyaloid Training Level 6
- Navigation Training Level 4
- Posterior Hyaloid Training Level 1
- Posterior Hyaloid Training Level 2

VRT-B Epiretinal Membranes

Course description

The VRT-B Epiretinal Membranes simulator course combines preparatory basic tasks for laser and scissors with peelings of epiretinal and diabetic membranes. In the Epiretinal Membrane tasks, membranes with varying shapes and degrees of adherence have to be manipulated with different instruments and finally removed with the vitrector.

Required score: 60 of 100 points
Reliability gate: 3

Tasks

- Epiretinal Membrane Training Level 1
- Laser Coagulation Level 4
- Epiretinal Membrane Training Level 2
- Bimanual Scissors Training Level 5
- Epiretinal Membrane Training Level 3

VRT-B The Internal Limiting Membrane

Course description

This simulator course teaches peeling of the internal limiting membrane (ILM). The Forceps Training trains precise forceps handling needed for gripping and peeling of membranes. In the abstract Anti-Tremor Training task trainees will practice the rhexis-like circular movement for controlling the detachment process. In the ILM tasks, a dyed membrane has to be peeled off; an initial flap will already be prepared.

Required score: 60 of 100 points
Reliability gate: 3

Tasks

- ILM Peeling Level 1
- Forceps Training Level 5
- ILM Peeling Level 2
- Anti-Tremor Training Level 5 (Circle)
- ILM Peeling Level 3

5.3 VRT-C Advanced courses

The advanced VRT-C tier refines already acquired surgery skills by training multi-step vitreoretinal procedures under increasingly demanding conditions, such as treatment of retinal detachment.

Training objectives

- Consistent control of tremor in stressful surgical scenarios
- Greater awareness of tissue tolerance during grasping and peeling of highly adherent and/or unstained membranes
- Enhanced proficiency with the non-dominant hand in peeling highly adherent ILM and epiretinal membranes
- Understanding of how cutting rates and directional movements of the vitrectomy probe optimize cutting efficiency with reduced tractional forces on the retina
- Use of silicone oil and PFC liquid

Courses

- VRT-C Navigation and Instruments
- VRT-C Posterior Hyaloid Detachment
- VRT-C Epiretinal Membranes
- VRT-C The Internal Limiting Membrane
- VRT-C Retinal Detachments
- VRT-C The Non-Dominant Hand

Requirements for simulator courses

All simulator tasks have to be completed in **sequential order**. The microscope needs to be set up at the start. It maintains its focus and zoom between tasks. A **required score of 80 points** must be reached with a reliability of **three times in a row** to advance to the next task of the course. After a task has been completed, it may be repeated for further practice.

VRT-C Navigation and Instruments

Course description

The VRT-C Navigation and Instruments simulator course repeats the instrument skills and movements acquired in previous courses on a higher level of difficulty. Trainees will refine their one-handed and bimanual instrument movements as well as the handling of forceps and light source in abstract scenarios.

Required score: 80 of 100 points
Reliability gate: 3

Tasks

- Forceps Training Level 7
- Anti-Tremor Training Level 4
- Bimanual Training Level 5
- Anti-Tremor Training Level 6
- Forceps Training Level 6
- Anti-Tremor Training Level 7

VRT-C Posterior Hyaloid Detachment

Course description

This simulator course offers training of posterior hyaloid removal including working with an indented eye for peripheral removal, staining the hyaloid as well as configuring the vitrectomy machine. Trainees will also deepen their understanding of different optics. In three tasks, they will have to detach and remove a firmly attached hyaloid, which is pre-stained, unstained, or – in the most demanding task – has to be stained at first.

Required score: 80 of 100 points
Reliability gate: 3

Tasks

- Posterior Hyaloid Level 3
- Posterior Hyaloid Level 4
- Posterior Hyaloid Level 5, No Guidance

VRT-C Epiretinal Membranes

Course description

The VRT-C Epiretinal Membranes simulator course aims at refining peeling techniques and the use of various required instruments, such as forceps, picks, and vitrector. Trainees will have to peel epiretinal and diabetic membranes along the vascular arcades and in the macula area.

Required score: 80 of 100 points
Reliability gate: 3

Tasks

- Epiretinal Membranes Level 4
- Epiretinal Membranes Level 5
- Epiretinal Membranes Level 6, No Guidance

VRT-C The Internal Limiting Membrane

Course description

In this simulator course, skills needed in peeling of the inner limiting membrane (ILM) are trained on a more advanced and demanding level; trainees will have to create an initial flap in a membrane which adheres strongly to the retina, and therefore tends to fragment easily. The membrane will either be slightly dyed or not dyed at all.

Required score: 80 of 100 points
Reliability gate: 3

Tasks

- ILM Peeling Level 4
- ILM Peeling Level 5
- ILM Peeling Level 6, No Guidance

VRT-C Retinal Detachments

Course description

The VRT-C Retinal Detachments simulator course teaches reattaching the retina by replacing the vitreous humor with perfluorocarbon liquid (PFC). Trainees will practice the injection of PFC with a cannula and improve their vitrector skills by removing tractive tissue parts around retinal holes of varying sizes and in varying positions. A laser has to be used to seal the retinal hole. Finally, the OR machine has to be configured for silicone oil or air infusion and the PFC has to be removed using a passive aspirator.

Required score: 80 of 100 points
Reliability gate: 3

Tasks

- Retinal Detachments Training Level 1
- Retinal Detachments Training Level 2
- Retinal Detachments Training Level 3, No Guidance

VRT-C The Non-Dominant Hand

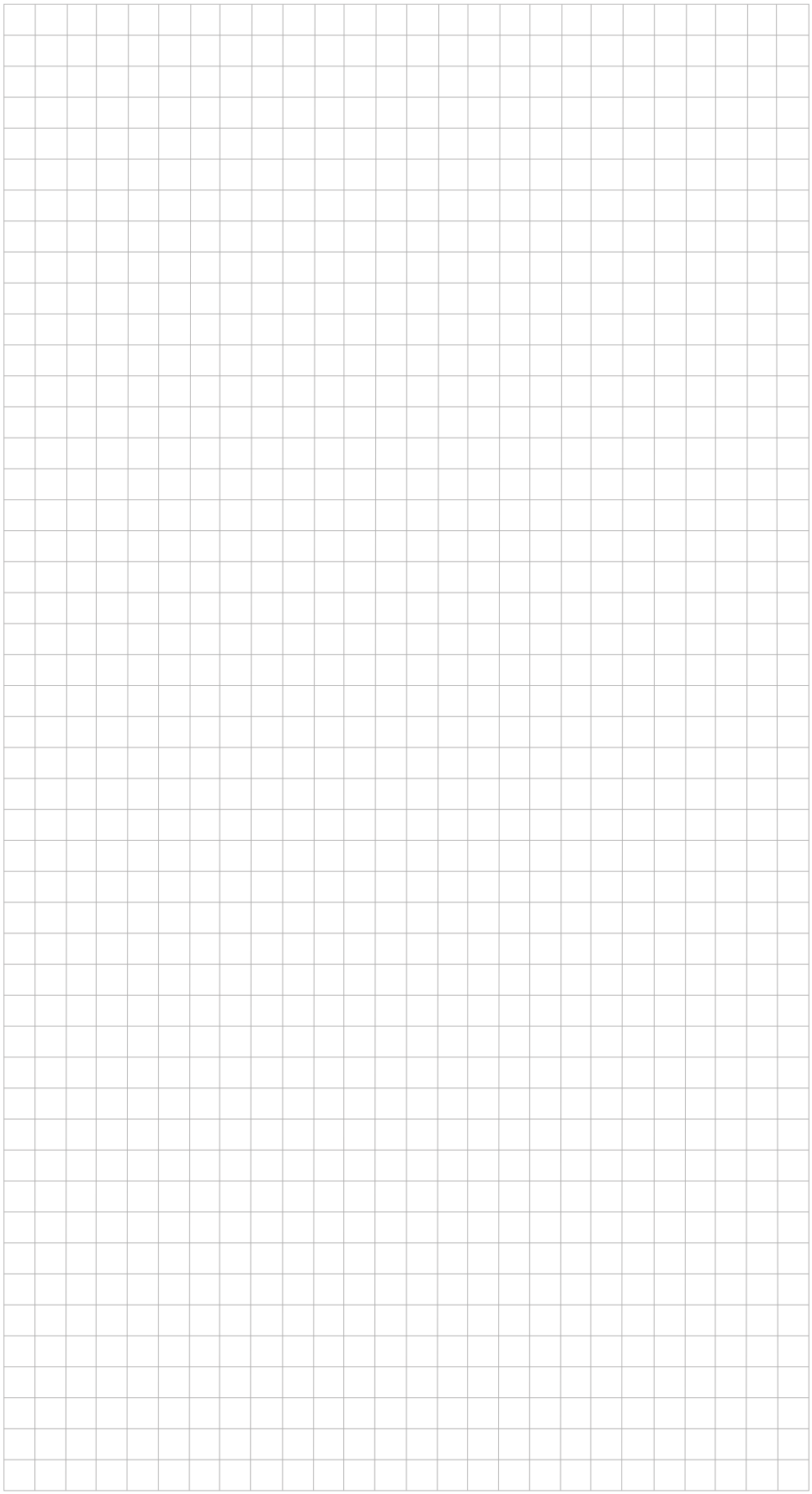
Course description

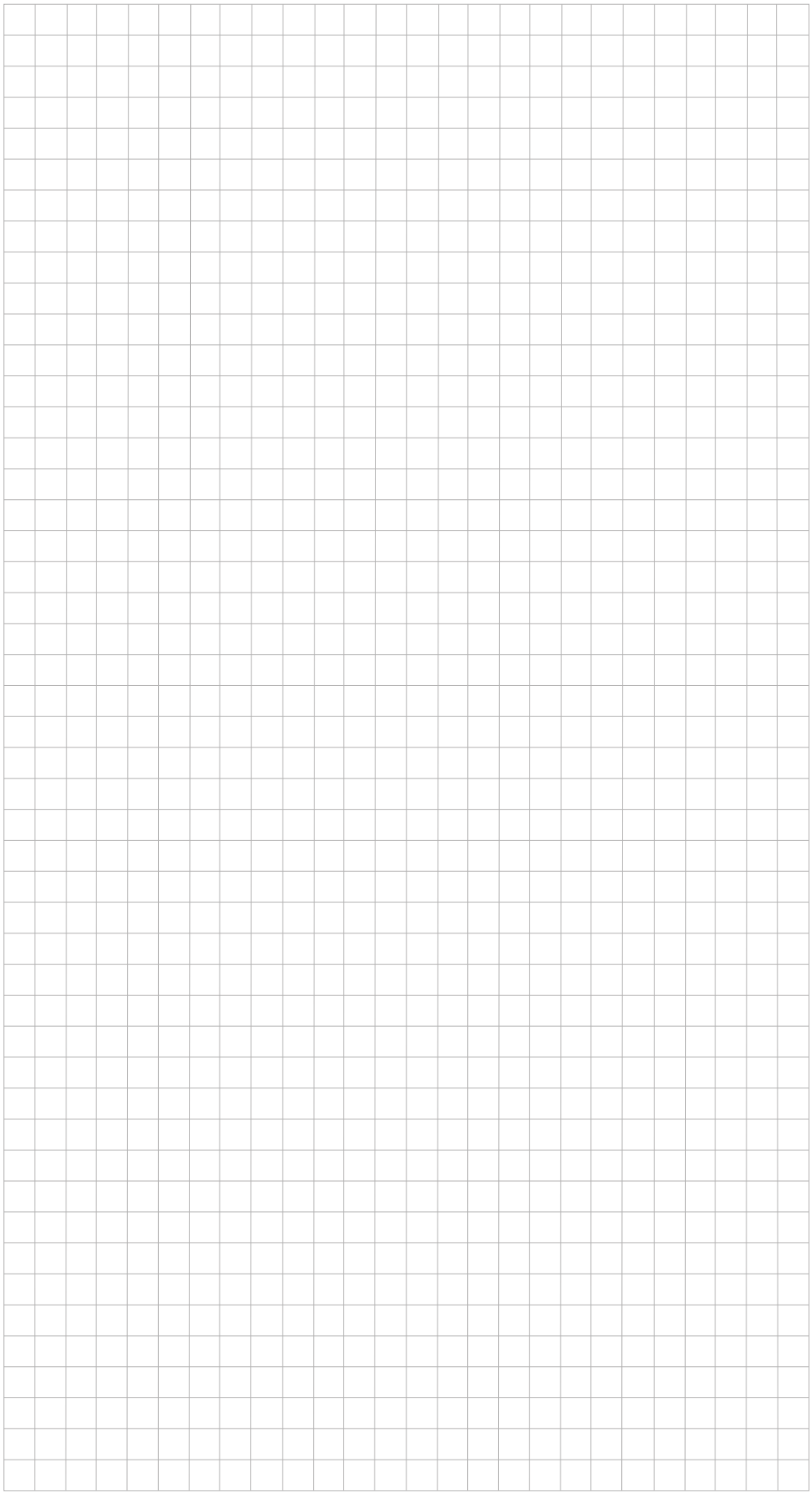
This simulator course practices peeling of the internal limiting membrane and of epiretinal membranes using the non-dominant hand. In the ILM tasks, trainees will have to create an initial flap in a membrane which adheres strongly to the retina, and therefore tends to fragment easily. The membrane will either be slightly dyed or not dyed at all. In the Epiretinal Membrane Training tasks, membranes along arcades and in the macula area have to be removed.

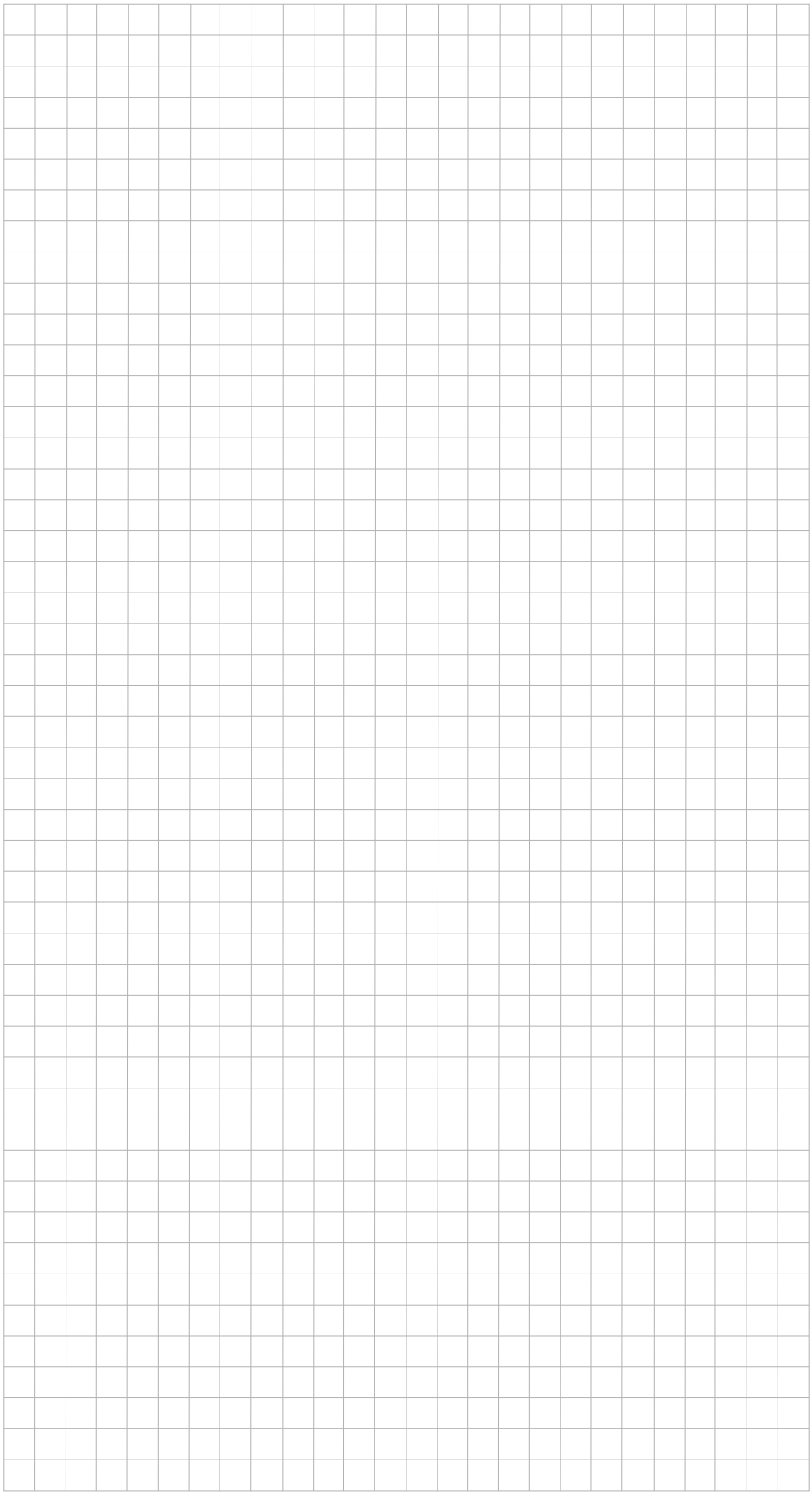
Required score: 80 of 100 points
Reliability gate: 3
Options: usage of non-dominant hand

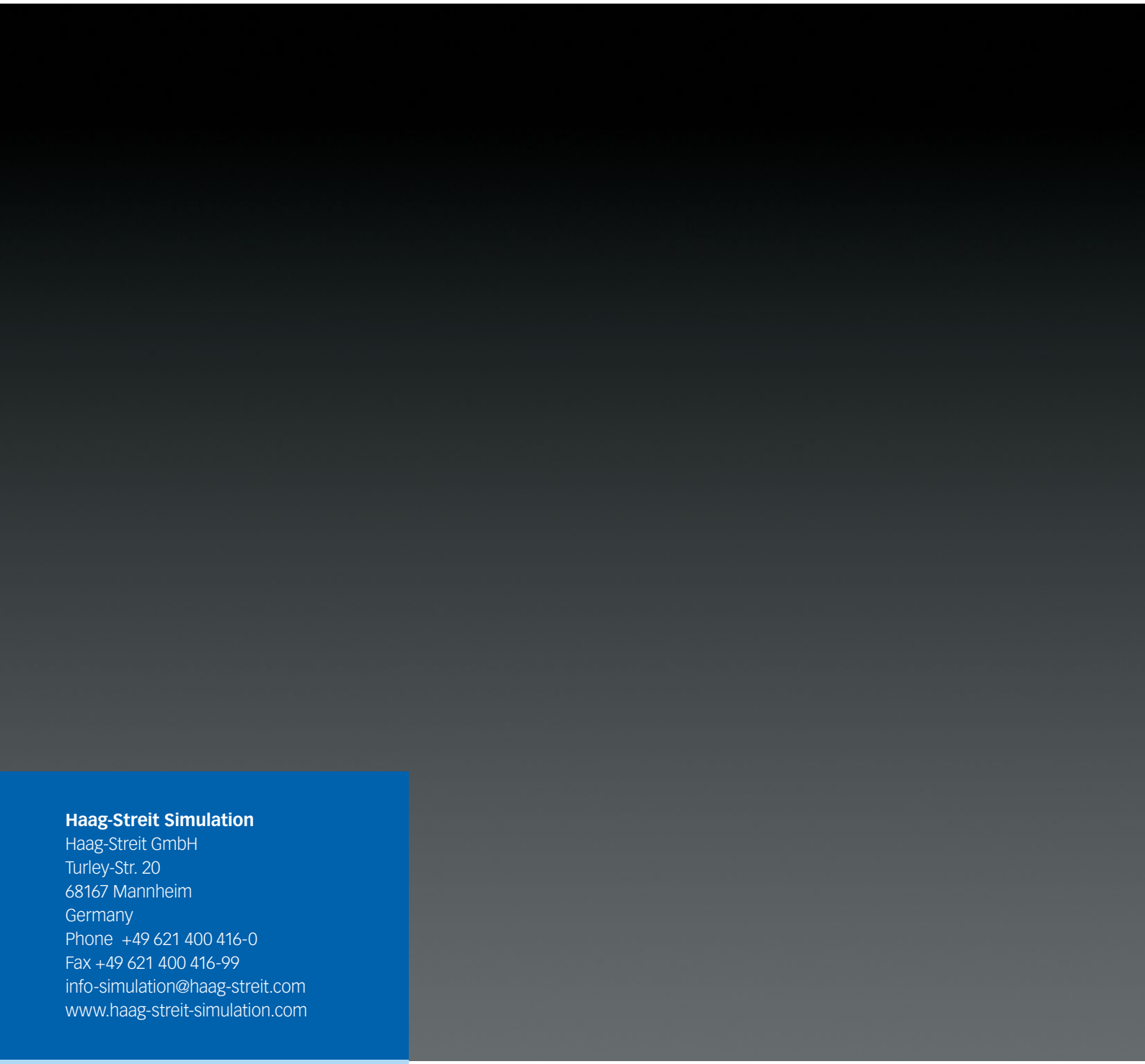
Tasks

- ILM Peeling ND Level 4
- Epiretinal Membrane Training ND Level 4
- ILM Peeling ND Level 6
- Epiretinal Membrane Training ND Level 6









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