Anterior Region (Robbins Level VI: Superior Part)

9

Core Messages

- In this chapter, we shall explore especially the larynx and the hypopharynx. In all surgical specialities in recent years, there has been an increased preference for the conservative approach to malignant tumours. This is particularly true in oncological surgery of the larynx, thanks especially to endoscopic laser surgery and to the supracricoid (reconstructive) laryngectomies. The precise anatomical knowledge of the larynx, as regards both its surface appearance and its deep spaces, and of the preferential means of diffusion of neoplasias is of fundamental importance to allow the surgical indication to be as conservative as possible without decreasing the survival percentage.

9.1 Anatomic Layout

This area coincides with the superior part of Robbins level VI. We begin dissection from the top starting from the hyoid bone, which we identify by palpation to distinguish its parts: the body, the greater cornu, and the lesser cornu, the latter being close to the point of insertion of the stylohyoid muscles (Fig. 9.1).

Significant Anatomical Structures: hyoid bone, larynx, quadrangular membrane, conus elasticus, Galen's loop, superior laryngeal nerve, cricothyroid space, cricothyroid artery, preepiglottic space, inferior constrictor muscle of pharynx, cricopharyngeus muscle, Laimer's triangle, Zenker diverticula, piriform sinus, retrocricoid area, lingual "V", glossoepiglottic valleculae, Morgagni's ventricle, posterior commissure, paraglottic spaces, thyroepiglottic ligament, aryepiglottic fold, vocal process of arytenoid cartilage, Reinke's space, anterior commissure

Landmarks: mental prominence, carotid tubercle, greater cornu of hyoid bone, foramen cecum, threefold region, laryngeal corner

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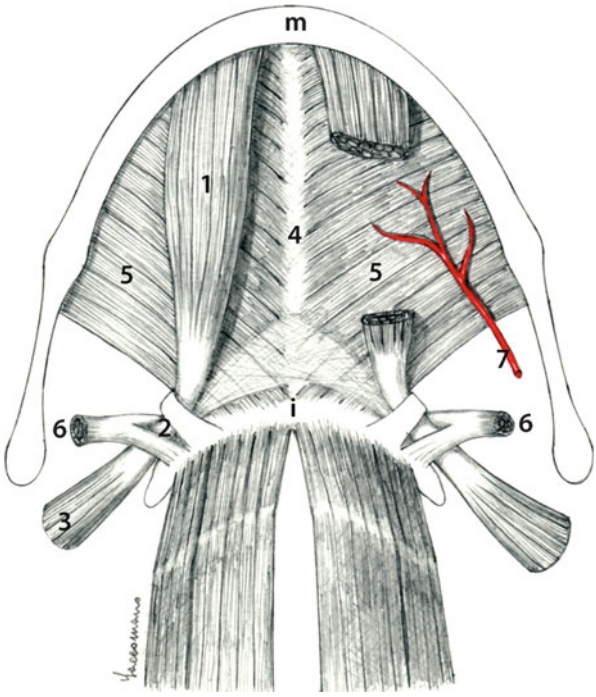

Fig. 9.1 Hyoid bone and interdigastric space. *m* Mandible, *i* hyoid bone, *1* anterior belly of the digastric muscle, *2* intermediate tendon of the digastric muscle, *3* posterior belly of the digastric muscle, *4* suprahyoid linea alba, *5* mylohyoid muscle, *6* stylohyoid muscle, *7* submental artery

9.2 Hyoid Area

We recognise the submental triangle, also referred to as the interdigastric space, which we already drained in a previous exercise and which corresponds to Robbins level Ia. The suprahyoid linea alba runs from the mental prominence to the hyoid bone and is formed by fusion of the mylohyoid muscles on the midline (Fig. 9.2).

The hyoid bone is the only bone that is not joined to the rest of the skeleton; instead, in most vertebrates it is joined through the ossification of that structure which, in exceptional cases, is ossified also in man, that is, the stylohyoid ligament. It is an important point for the support of the larynx during the ample craniocaudal excursions of deglutition (which may be as much as 2–3 cm) (Fig. 9.3).

The sternohyoid and sternothyroid muscles already interrupted at the bottom are removed. The thyrohyoid muscles are sectioned at the point of insertion in the thyroid cartilage and hyoid bone and then ablated, thereby exposing the thyrohyoid membrane (Fig. 9.4).

The larynx is thus completely exposed. Posteriorly, the hypopharynx is separated from the prevertebral plane (Fig. 9.5).

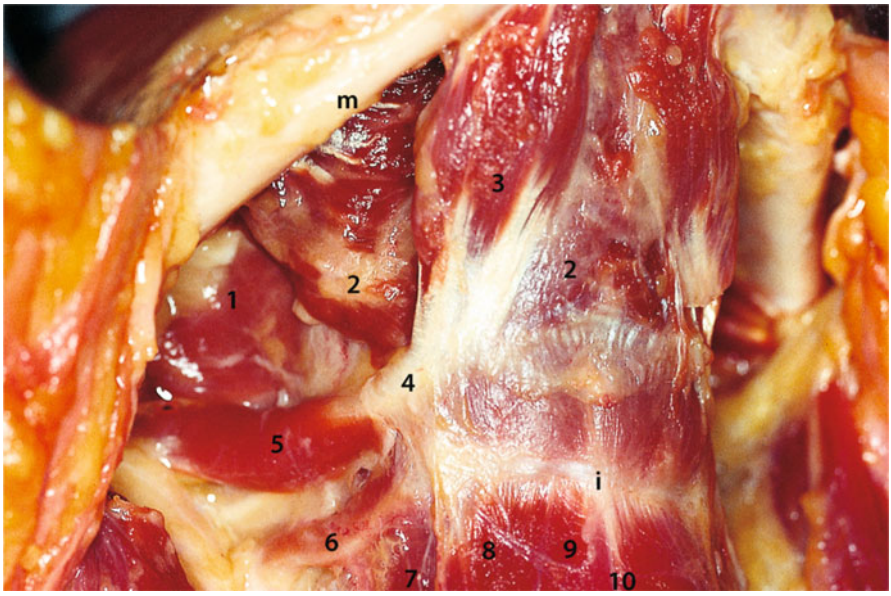

Fig. 9.2 Hyoid area (I). *m* Mandible, *i* hyoid, *l* hyoglossal muscle, *2* mylohyoid muscle, *3* anterior belly of the digastric muscle, *4* intermediate tendon of the digastric muscle, *5* posterior belly of the digastric muscle, *6* greater cornu of the hyoid bone, *7* thyrohyoid muscle, *8* omohyoid muscle, *9* sternohyoid muscle, *10* infrahyoid linea alba

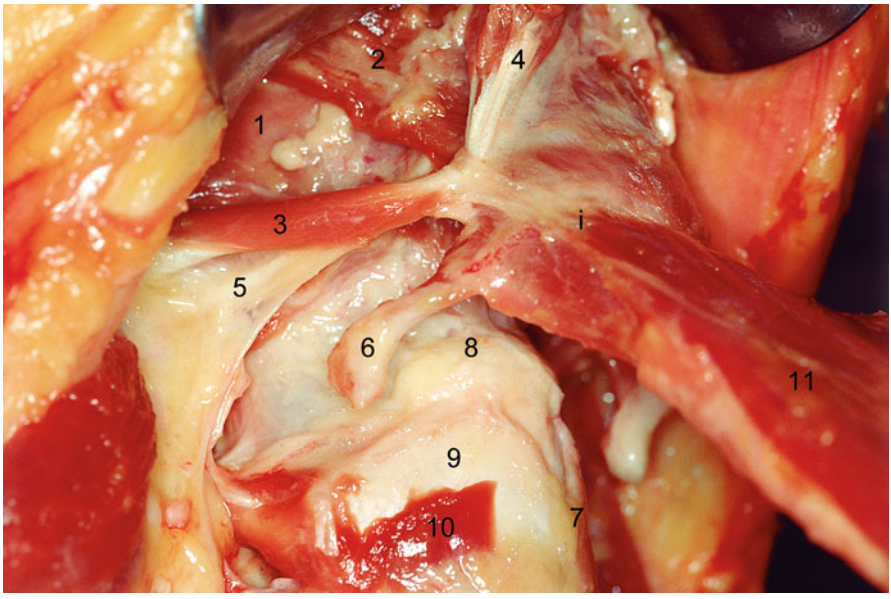

Fig. 9.3 Hyoid area (II). *i* Hyoid bone, *l* hyoglossal muscle, *2* mylohyoid muscle, *3* posterior belly of the digastric muscle, *4* anterior belly of the digastric muscle, *5* hypoglossal nerve, *6* greater cornu of the hyoid bone, *7* laryngeal prominence, *8* preepiglottic space, *9* thyroid lamina, *10* line of insertion of the thyrohyoid muscle, *11* sternohyoid muscle

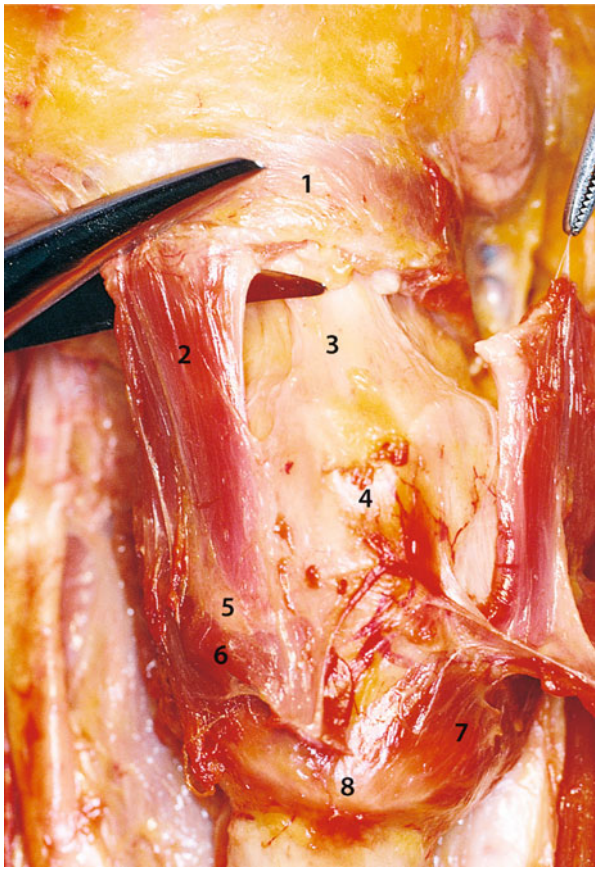

Fig. 9.4 Larynx and infrahyoid muscles. *1* Body of the hyoid bone, *2* thyrohyoid muscle, *3* thyrohyoid membrane, *4* laryngeal prominence, *5* line of insertion of the thyrohyoid muscle, *6* sternothyroid muscle (sectioned), *7* cricothyroid muscle, *8* cricoid ring

9.3 Larynx

The larynx is situated anteriorly to the hypopharynx, superiorly to the trachea, and inferiorly to the base of the tongue and hyoid bone. It is formed by the following structures:

1. A cartilaginous skeleton formed by 9 cartilages, 3 unpaired and 6 paired, with two articulations (cricothyroid and cricoarytenoid).
2. Two elastic submucous membranes: the quadrangular membrane and the conus elasticus. The first extends from the lateral margin of the epiglottis to the anterolateral aspect of the corresponding arytenoid cartilage, supporting the aryepiglottic fold. The second extends from the margin of the vocal fold, where it thickens to form the vocal ligament, to the superior margin of the cricoid cartilage.
3. Three fibroelastic sheets: the hyoepiglottic membrane, the thyrohyoid membrane, and the cricothyroid membrane.
4. Intrinsic muscles for moving the mobile parts of the larynx (arytenoid cartilages, vestibular folds, and vocal folds). Adduction movements are affected by the interarytenoid (transverse and oblique) and lateral cricoarytenoid muscles and abduction movements by the posterior cricoarytenoid muscles; vocal cord tension is provided by the thyroarytenoid and cricothyroid muscles (Fig. 9.6).

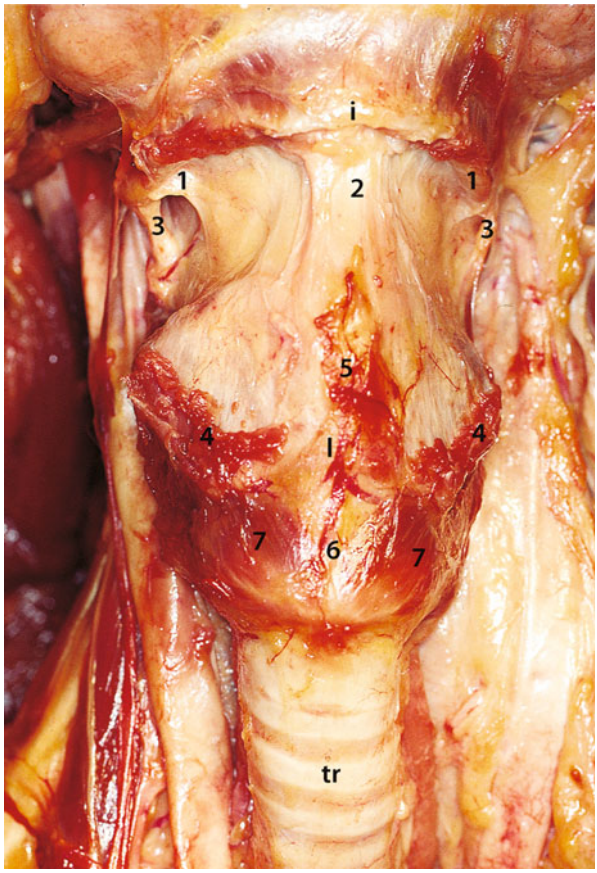

Fig. 9.5 Larynx: anterior view. *i* Hyoid bone, *l* larynx, *tr* trachea, *1* greater cornu of the hyoid bone, *2* thyrohyoid membrane, *3* thyrohyoid ligament, *4* line of insertion of the thyrohyoid muscle, *5* laryngeal protuberance, *6* cricothyroid membrane, *7* cricothyroid muscle

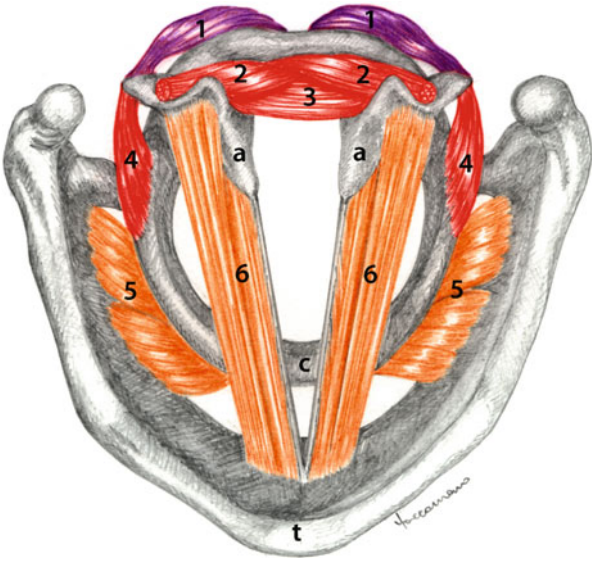

Fig. 9.6 Intrinsic laryngeal muscles. *c* Cricoid cartilage, *t* thyroid cartilage, *a* arytenoid cartilage, *1* posterior cricoarytenoid muscle, *2* interarytenoid muscle (oblique component), *3* interarytenoid muscle (transverse component), *4* lateral cricoarytenoid muscle, *5* cricothyroid muscles, *6* thyroarytenoid muscles

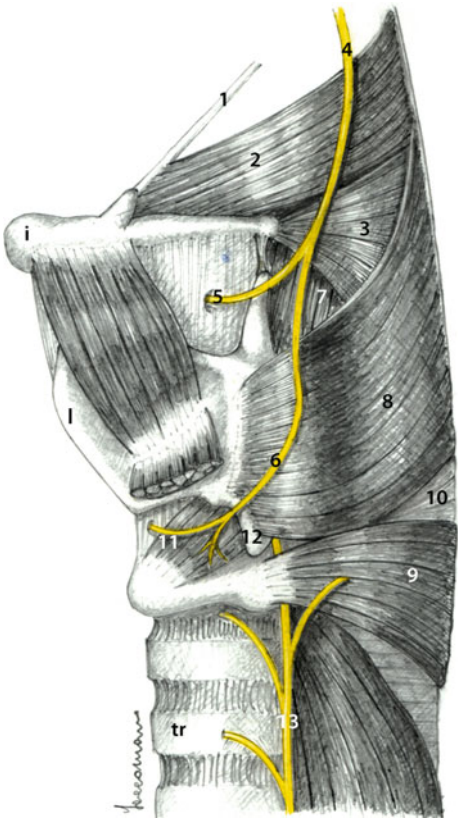

Fig. 9.7 Laryngeal nerves. *i* Hyoid bone, *l* larynx, *tr* trachea, *1* stylohyoid ligament, *2* middle constrictor muscle of the pharynx (superior component), *3* middle constrictor muscle of the pharynx (inferior component), *4* superior laryngeal nerve, *5* internal branch of the superior laryngeal nerve, *6* external branch of the superior laryngeal nerve, *7* palatopharyngeal muscle, *8* inferior constrictor muscle of the pharynx, *9* cricopharyngeal muscle, *10* Laimer's triangle, *11* cricothyroid muscle, *12* inferior cornu of the thyroid cartilage, *13* recurrent nerve

5. The larynx is vascularised by the superior laryngeal and cricothyroid branches of the superior thyroid arteries; a minor contribution is made by the inferior laryngeal branches of the inferior thyroid arteries.
6. The intrinsic muscles are innervated by the inferior laryngeal nerve, except for the cricothyroid muscle, which is served by the superior laryngeal nerve (external branch). Sensory innervation is provided by the superior laryngeal nerve for the supraglottic mucosa and by the recurrent nerve for the inferior aspect of the vocal folds and hypoglottis (Fig. 9.7).

At this point we have "skeletised" the larynx and hypopharynx, though without interrupting the superior laryngeal pedicles which enter the larynx at the level or the thyrohyoid membrane. The inferior boundary of the larynx, corresponding to the inferior margin of the cricoid cartilage, is at the level of the sixth cervical vertebra, whose transverse process, which juts out further than the others, is called the carotid tubercle (already indicated as a landmark). The hypopharynx ends and the cervical oesophagus begins at this level (Fig. 9.8).

Regarding laryngeal innervation, we now identify the point of entry of the recurrent nerve into the larynx, which lies just beneath the inferior cornu of the thyroid cartilage.

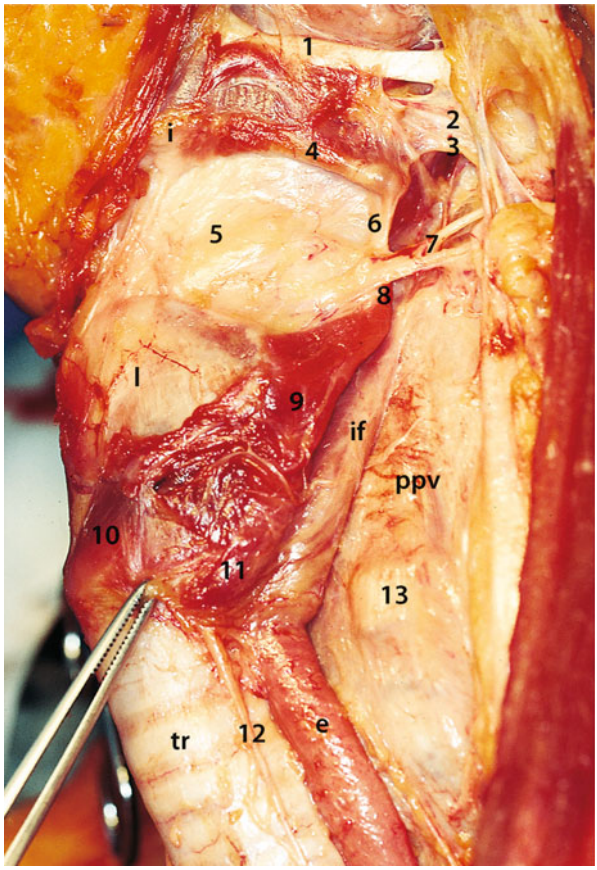

Fig. 9.8 Larynx: side view. *i* Hyoid bone, *l* larynx, *if* hypopharynx, *tr* trachea, *e* oesophagus, *ppv* prevertebral plane, *1* intermediate tendon of the digastric muscle, *2* hypoglossal nerve, *3* lingual artery, *4* greater cornu of the hyoid bone, *5* thyrohyoid membrane, *6* thyrohyoid ligament, *7* superior laryngeal pedicle, *8* superior cornu of the thyroid cartilage, *9* inferior constrictor muscle of the pharynx, *10* cricothyroid muscle, *11* cricopharyngeal muscle, *12* recurrent nerve, *13* VI cervical vertebra

Remarks: In supracricoid laryngectomies, the inferior cornu of the thyroid cartilage is generally sectioned, at least on the side where the arytenoid is preserved. In doing so the line of caudal resection is far from the recurrent nerve at its entrance into the larynx, and there is less risk of damaging it, which could cause fixity of the residual arytenoid.

In the larynx, the recurrent nerve divides into two terminal branches, a posterior one which serves the posterior cricoarytenoid muscle (sole abductor muscle of the vocal cords) and an anterior one which, with subsequent divisions, innervates all the other intrinsic muscles of the larynx.

With the branches of the superior laryngeal nerve, the sensory component of the recurrent nerve forms Galen's loop and, with afferents from the subglottic mucosa, runs into the extralaryngeal tract of the common recurrent trunk (Fig. 9.9).

The superior laryngeal nerve is then identified and followed. Laterally, at the apex of the greater cornu of the hyoid bone, it divides into an internal branch (component of the superior laryngeal pedicle), which penetrates the thyrohyoid membrane and conducts sensory fibres to the supraglottic portion of the larynx, and an

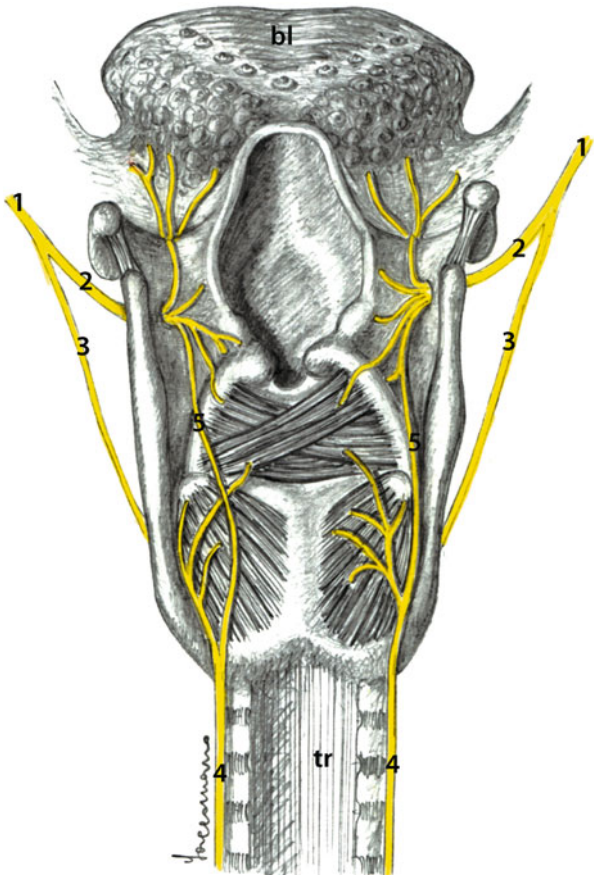

Fig. 9.9 Laryngeal nerves and Galen's loop. *bl* Tongue base, *tr* trachea, *1* superior laryngeal nerve, *2* internal branch of the superior laryngeal nerve, *3* external branch of the superior laryngeal nerve, *4* recurrent nerve, *5* Galen's loop

external branch, which runs obliquely in an anteroinferior direction to innervate the cricothyroid muscle; it then perforates the cricothyroid ligament and transmits sensory fibres to the glottis and the laryngeal ventricle (Fig. 9.10).

Remarks: The reason why the superior laryngeal nerve is preserved in functional laryngectomies is to preserve sensitivity as much as possible at glottic and subglottic level and in the piriform sinus. It is believed that this facilitates the functional recovery of deglutition in the postoperative period.

Complications: Accidental injury to the superior laryngeal nerve during ligation of the superior thyroid pedicle causes homolateral hypotonia of the vocal cord, which on laryngoscopy can be seen lying below the level of the contralateral one, leading to dysphonia of prevalently acute pitch. Another outcome is homolateral supraglottic hemilaryngeal anaesthesia.

The thyrohyoid membrane joins the superior margin of the thyroid cartilage and the hyoid bone. Its lateral margins thicken to form two fibrous ligaments (thyrohyoid ligaments), which join the superior cornu of the thyroid cartilage to the apex of the greater cornu of the hyoid bone.

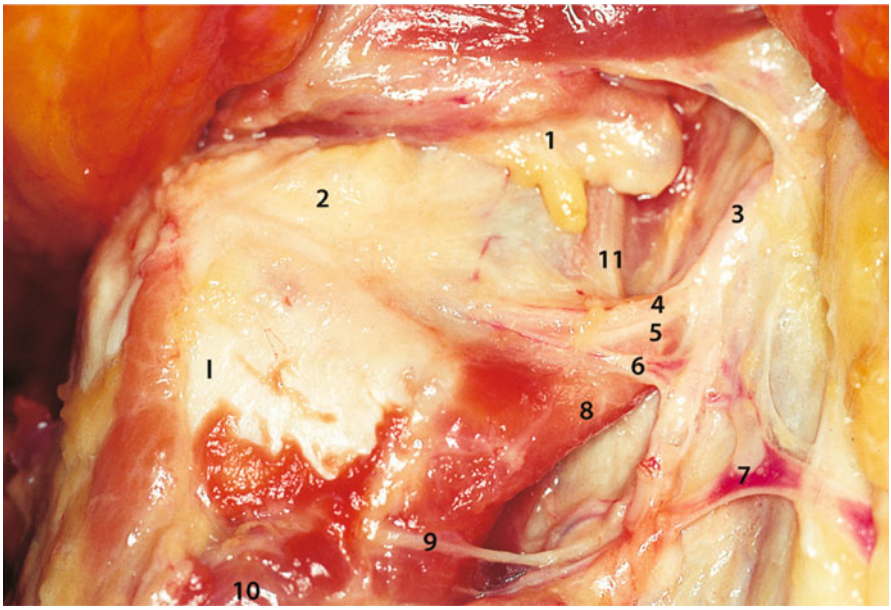

Fig. 9.10 Superior laryngeal pedicle. *l* Larynx, *1* greater cornu of the hyoid bone, *2* thyrohyoid membrane, *3* superior thyroid artery, *4* superior laryngeal artery, *5* internal branch of the superior laryngeal nerve, *6* superior laryngeal vein, *7* superior thyroid vein, *8* superior cornu of the thyroid cartilage, *9* external branch of the superior laryngeal nerve, *10* cricothyroid muscle, *11* thyrohyoid ligament

Remarks: The thyrohyoid ligaments and posterior margins of the thyroid cartilage correspond to the lateral hypopharyngeal walls and are a good landmark for lateral pharyngotomy, providing access to the piriform recesses and vestibule of the larynx in surgery in this region.

In the lateral portion of the thyrohyoid membrane, we identify the point where the laryngeal pedicle enters the larynx. It is formed by the superior laryngeal artery and by the corresponding vein and nerve. We see how the vessels come from the superior thyroid pedicle, while the superior laryngeal nerve, which is deeper down, comes from the vagus nerve. We ligate and section the pedicle.

The cricothyroid space is well identified and defined by palpation. This space is easily accessible in laryngotracheal lumen surgery, should severe respiratory stenosis require emergency incision (intercricothyroid laryngotomy). This is in fact the point where the respiratory lumen is closest to the skin of the neck. In performing the manoeuvre, the only significant vessel that may be encountered in this region is the cricothyroid artery, a ramification of the lateral branch of the superior thyroid artery. The same vessel may also be encountered in endoscopic laser surgery of the anterior glottis, when extending the subperichondrial exeresis downwards.

Remarks: A small depression internally corresponding to the anterior commissure is appreciable by palpation between the third superior and third median of the anterior profile of the thyroid cartilage. This landmark is important in functional

laryngeal surgery, in particular in supraglottic horizontal laryngectomy when, with Lister's forceps, the thyroid cartilage is sectioned transversely and its vestibular portion is removed.

The thyrohyoid membrane, hyoepiglottic membrane, and infrahyoid epiglottis bound the hyothyroepiglottic or preepiglottic space. Its contents essentially consist of celluloadipose tissue, to which supraglottic tumours easily spread. Accordingly, supraglottic laryngectomy usually includes its complete ablation.

9.4 Hypopharynx

The hypopharynx extends from the superior margin of the hyoid bone to the inferior margin of the cricoid cartilage. It is formed by two lateral grooves (piriform sinuses), a retrocricoid portion (corresponding to the cricoid lamina) and a posterior wall. The palatopharyngeal muscles and inferior and middle constrictors of the pharynx provide the muscular coat.

We can observe the hypopharyngeal muscles morphology, in particular how the middle constrictor muscle inserts in the greater cornu of the hyoid bone. The inferior constrictor muscle of the pharynx has two components: the first, which is much larger, runs obliquely and inserts into the lateral margin of the thyroid cartilage, while the second, with horizontal fibres, inserts in the lateral margin of the cricoid cartilage. This portion of the inferior constrictor muscle of the pharynx is called the cricopharyngeus muscle. The middle and inferior constrictors are innervated by the vagus nerve.

Remarks: The inferior constrictor corresponds to the muscular plane in the reconstruction of the hypopharynx after total laryngectomy. Longitudinal myotomy of the inferior constrictor muscle is an operation frequently associated with the creation of a phonatory fistula after total laryngectomy. A spasm or a fibrosis of the muscular sheath may cause aphonia. In this case the operation tends to obtain a greater elastic compliance of the hypopharynx and therefore optimum functioning of the phonatory prosthesis. It should also be remembered that, posteriorly, the oblique fibres of the superior portion of the inferior constrictor muscle of the pharynx and the horizontal fibres of its inferior portion (cricopharyngeus muscle) describe a triangle with an inferior base, lacking in muscular fibres and with lower resistance. Said space, referred to as Laimer's triangle, is the place where Zenker's diverticula are formed (Fig. 9.11).

We rotate the larynx just enough to reveal the profile of the lateral margin of the thyroid cartilage under the inferior constrictor: the sectioning of this muscle along this margin is the preliminary surgical step to obtain access to the piriform sinus.

9.5 Laryngectomy

At this point, it is preferable to remove the larynx and hypopharynx en bloc in order to explore internal laryngeal morphology. A horizontal incision is made at the level of the second tracheal ring, where the trachea and cervical oesophagus are at full thickness.

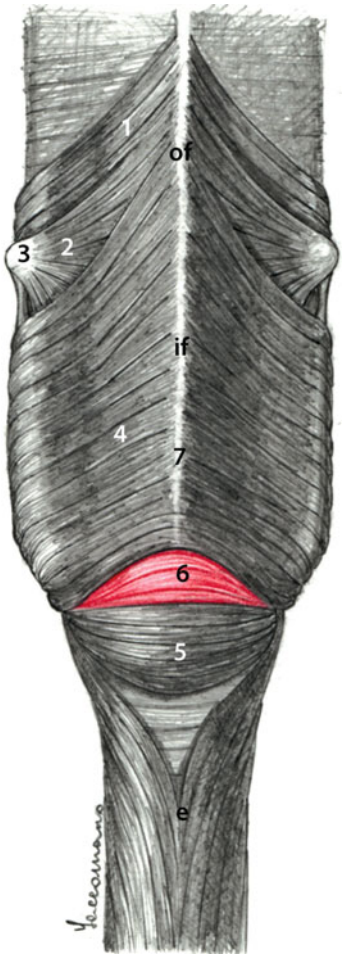

Fig. 9.11 Constrictor muscles of the pharynx. *of* Oropharynx, *if* hypopharynx, *e* oesophagus, *1* middle constrictor muscle of the pharynx (superior component), *2* middle constrictor muscle of the pharynx (inferior component), *3* apex of the greater cornu of the hyoid bone, *4* inferior constrictor muscle of the pharynx, *5* cricopharyngeal muscle, *6* Laimer's triangle, *7* posterior pharyngeal raphe

The laryngo-hypopharyngeal block is separated from the vertebral plane up to the hyoid bone. After opening the lateral hypopharyngeal wall, the tongue base is sectioned horizontally 4–5 cm. superior to the epiglottis and the posterior pharyngeal wall a few centimetres caudal, thereby separating the orohypopharynx and larynx en bloc. On the removed piece, a vertical incision is made in the posterior wall of the hypopharynx, thereby exposing the vestibule of the larynx and the retrocricoid area (Fig. 9.12).

Exercise 8: laryngectomy (Fig. 9.13)

Alternatively, for those who are interested, we propose the ablation of the larynx as is performed in the classic procedure of total laryngectomy. The manoeuvres described are performed on both sides.

After having gripped and laterally rotated the larynx, the inferior constrictor and the perichondrium are sectioned along the lateral margin of the thyroid cartilage (Fig. 9.13a).

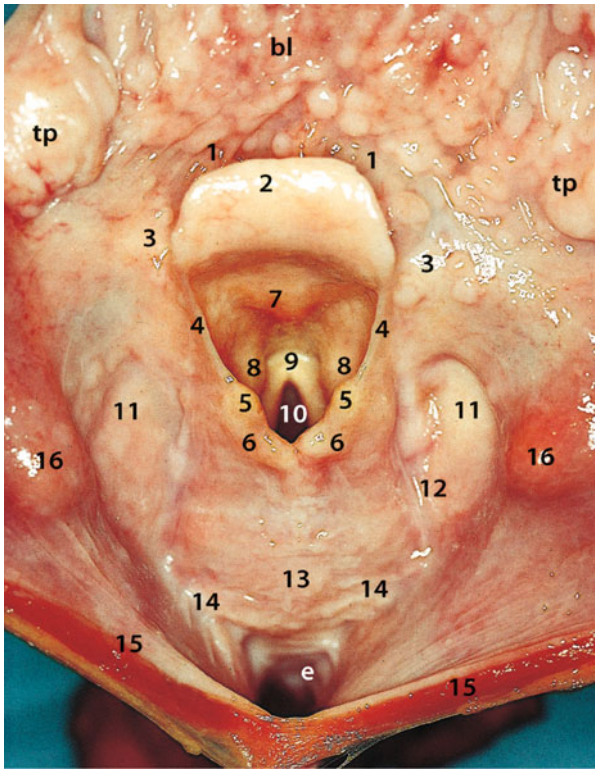

Fig. 9.12 Larynx and hypopharynx: intraluminal view (I). *bl* Tongue base, *tp* palatine tonsil, *e* oesophagus, *1* glossoepiglottic vallecula, *2* epiglottis, *3* pharyngoepiglottic fold, *4* aryepiglottic fold, *5* cuneiform tubercle (Wrisberg), *6* corniculate tubercle (Santorini), *7* epiglottic tubercle (petiole), *8* ventricular fold, *9* anterior commissure, *10* glottis, *11* piriform recess, *12* Galen's loop, *13* retrocricoid area, *14* Killian's mouth, *15* inferior constrictor muscle of the pharynx, *16* apex of the greater cornu of the hyoid bone

The thyroid cartilage is pulled up with a hook. We then proceed to separate the anterior wall of the piriform sinus with an internal subperichondrial approach (Fig. 9.13b).

We now section the trachea between the cricoid and the first tracheal ring. The hook pulls the cricoid ring upwards. The pars membranacea of the trachea is then dissected, without going to deep because this would take us into the oesophagus.

We go up posteriorly as far as the arytenoid cartilages, where we cut right through the mucosa and enter the hypopharynx (Fig. 9.13c).

Still pulling the larynx upwards, we continue to section the hypopharyngeal mucosa, keeping close to the larynx. The laryngectomy is concluded by transversely sectioning the mucosa of the glossoepiglottic valleculae (Fig. 9.13d).

Completion of the dissection caudal enables the three anatomic subareas of the hypopharynx to be extensively explored: that is, the retrocricoid area, piriform sinus, and posterior wall. A thread-like relief can be discerned, traversing the antero-superior part of each piriform sinus in a craniocaudal direction. It is the Galen's loop, the anastomosis between the internal branch of the superior laryngeal nerve and the recurrent nerve.

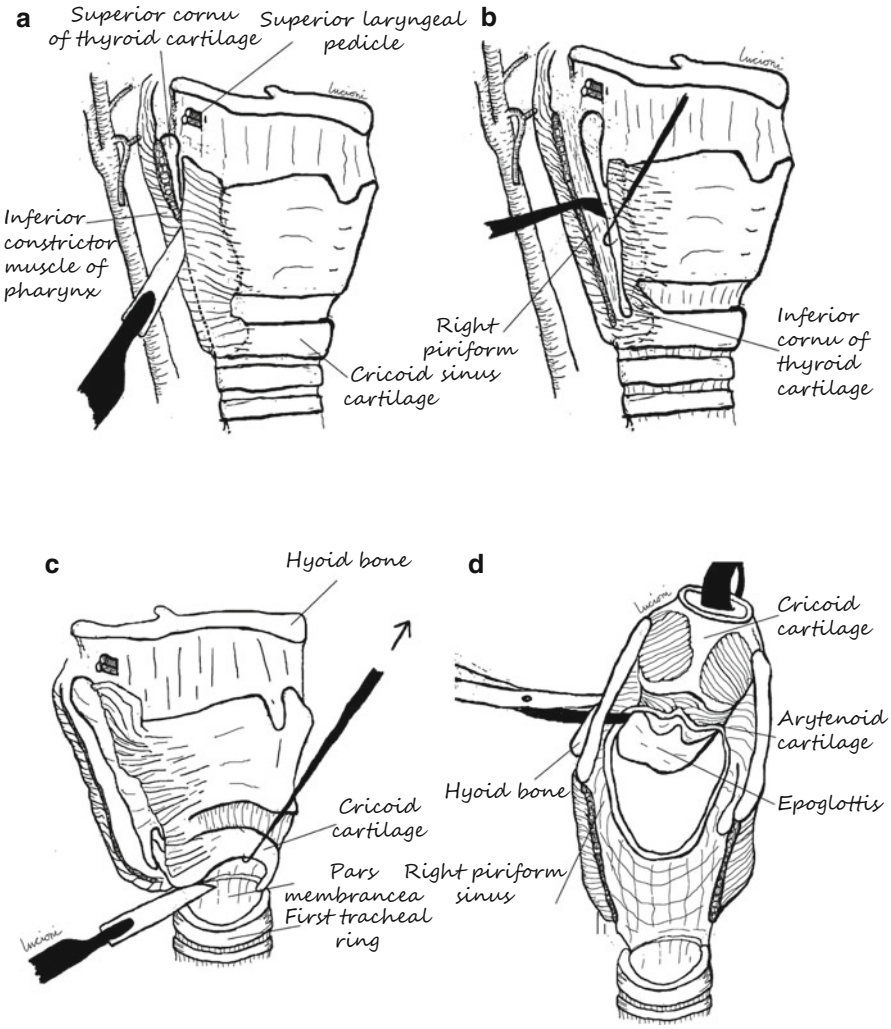

Fig. 9.13 Exercise no. 8: laryngectomy. (**a**) Dissection of inferior constrictor muscle. (**b**) Isolation of piriform sinus. (**c**) Dissection of trachea. (**d**) Ablation of larynx

Remarks: Tumours of the piriform sinus generally cause reflex otalgia: algogenic stimuli run along the superior laryngeal nerve and vagus nerve and reverberate in the external auditory canal. Stimulation of the external auditory canal cutis causes coughing via the same reflex arc (Fig. 9.14).

The lateral end of the greater cornu of the hyoid bone can be found by palpation laterally and superiorly at the entrance to the piriform sinus. The hyoid arch keeps

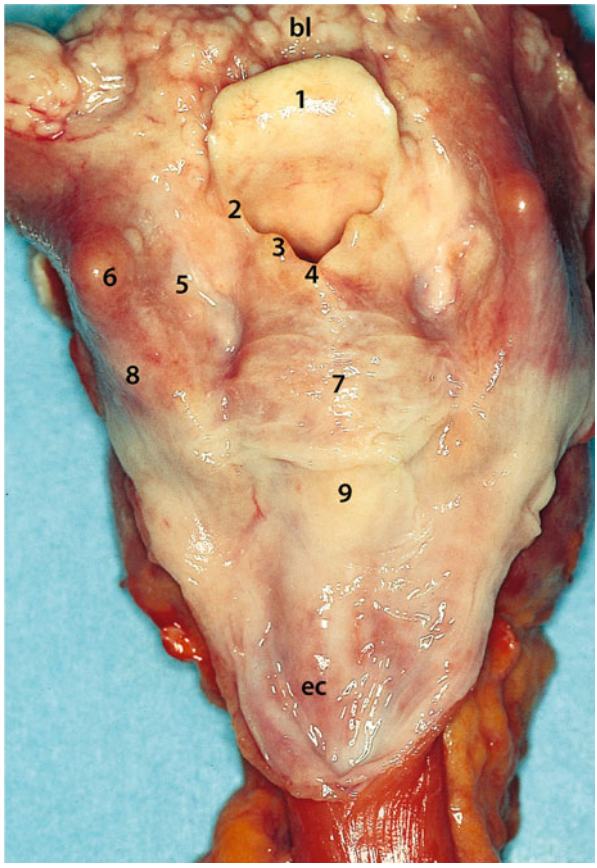

Fig. 9.14 Larynx and hypopharynx: intraluminal view (II). *bl* Tongue base, *ec* cervical oesophagus, *1* epiglottis, *2* aryepiglottic fold, *3* arytenoid, *4* posterior commissure, *5* piriform sinus, *6* greater cornu of the hyoid bone, *7* retrocricoid area, *8* posterior wall of the hypopharynx, *9* cricoid cartilage

the hypopharynx and entrance to the piriform sinuses open, aiding deglutition. This function is particularly important in the resumption of swallowing after partial or supracricoid laryngectomy.

The lingual "V" can be seen on observation of the anterior oropharynx. It is formed by the circumvallate papillae and separates the body from the base of the tongue and, at its apex, the foramen cecum. The lingual tonsil, formed by numerous more or less developed lymphatic follicles, can be seen just posteriorly. The foramen cecum may be the site of an ectopic thyroid and the point of onset of thyroglossal duct remnants (fistulas and congenital median cysts).

Remarks: In laryngeal surgery extending to the tongue base, the foramen cecum is considered the maximum limit of lingual exeresis to avoid severe dysphagia.

The pharyngoepiglottic fold is also clearly identifiable and represents the boundary between the oropharynx and hypopharynx and therefore also the superior limit of the piriform sinus (Fig. 9.15).

Between the base of the tongue and the epiglottis, the median and lateral glossoepiglottic folds delimit two depressions: the glossoepiglottic valleculae.

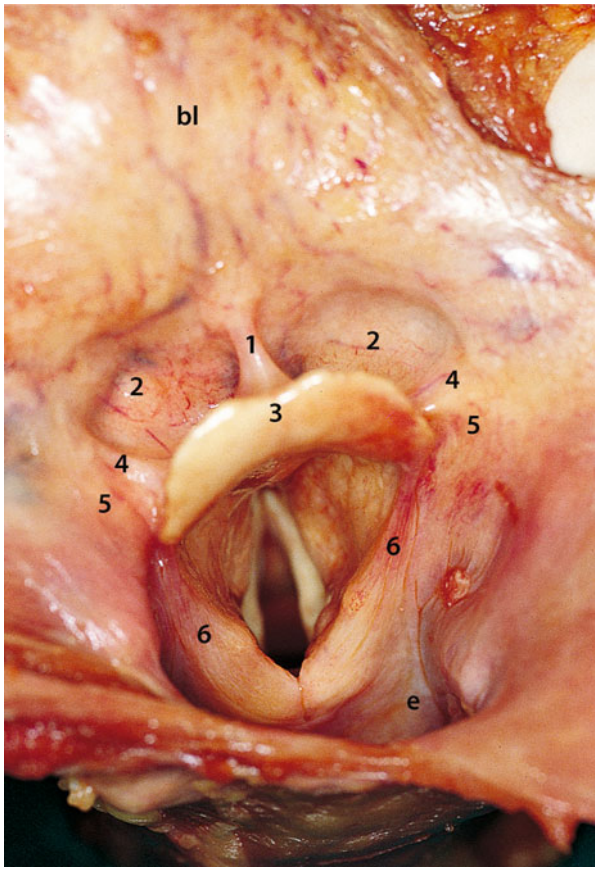

Fig. 9.15 Larynx and hypopharynx: intraluminal view (III). *bl* Tongue base, *e* oesophagus, *1* median glossoepiglottic fold, *2* glossoepiglottic vallecula, *3* suprahyoid epiglottis, *4* lateral glossoepiglottic fold, *5* pharyngoepiglottic fold, *6* aryepiglottic fold

Remarks: The glossoepiglottic valleculae mark the roof of the preepiglottic cavity, often invaded by tumours of the laryngeal lamina of the epiglottis; the neoplasia occasionally perforates the epiglottis and emerges anteriorly in the form of a "swelling" in the glossoepiglottic valleculae (Fig. 9.16). A potential site of pharyngolaryngeal tumours is the so-called "threefold region" (pharyngoepiglottic, aryepiglottic, and lateral glossoepiglottic folds) (Fig. 9.17).

We also examine the laryngeal aditus, as it will be observed during direct suspension laryngoscopy. It is bounded by the epiglottic margin, the aryepiglottic folds, the cuneiform and corniculate tubercles, and the posterior commissure between the two arytenoid cartilages. The cricoid lamina, situated inferiorly to the arytenoid cartilages, is between the two piriform sinuses. The vocal process of the arytenoids, where the vocal ligament is inserted, can be felt by palpation. From this position we identify the entrance to Morgagni's ventricle and assess how much the view of the ventricle floor is prevented by the ventricular fold. If we shift it to the side with forceps, we can have a better view (Fig. 9.18).

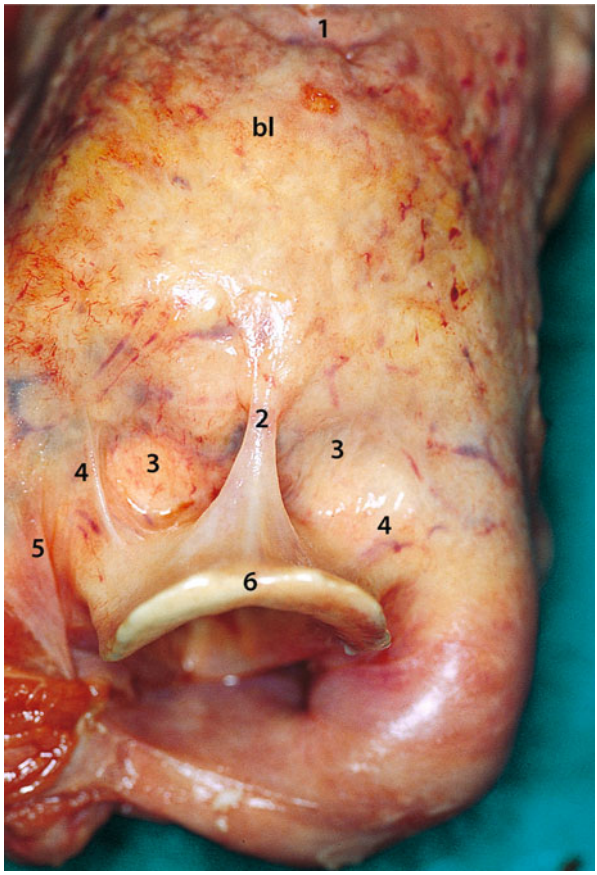

Fig. 9.16 Larynx and tongue base. *bl* Tongue base, *1* foramen cecum (apex of the "lingual V"), *2* median glossoepiglottic fold, *3* glossoepiglottic vallecula, *4* lateral glossoepiglottic fold, *5* pharyngoepiglottic fold, *6* epiglottis

Remarks: The preliminary stage of endoscopic laser cordectomy is nearly always vestibulectomy, that is, the ablation of the ventricular band. It is done simply in order to have a better exposure of the ventricle floor, the mucosa of which is very often completely removed. This also facilitates the cordectomy stage. The endoscopic follow-up is also more sure.

We now shift our angle of vision towards the anterior glottis, as though we were lifting the epiglottis with the laryngoscope. In this way we can examine the anterior commissure, the petiole, and the region of the laryngeal corner (Fig. 9.19).

The posterior laryngeal wall is then sectioned vertically along a line passing through the posterior commissure and involving the centre of the cricoid lamina. The vestibule of the larynx, the glottic plane, and the hypoglottis are exposed by divaricating the dissection margins with a self-retaining retractor (Fig. 9.20).

The anterior commissure region is also clearly evident (Fig. 9.21).

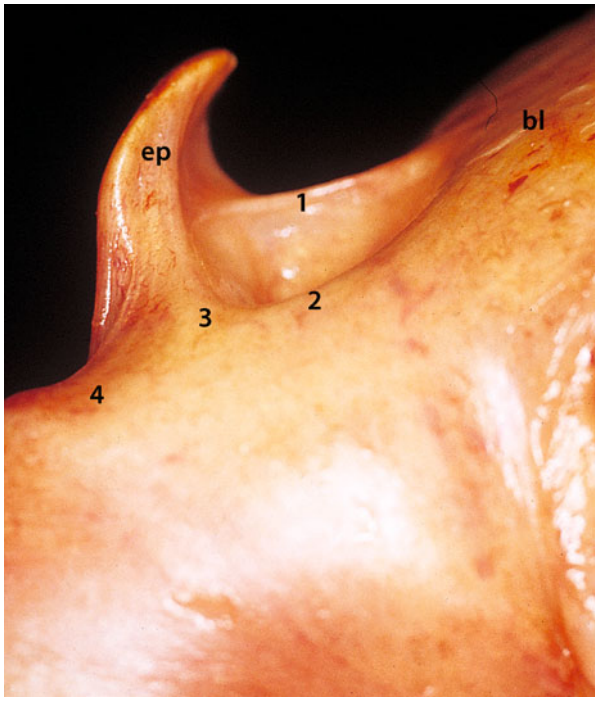

Fig. 9.17 Region of the three folds. *ep* Epiglottis, *bl* tongue base, *1* median glossoepiglottic fold, *2* lateral glossoepiglottic fold, *3* pharyngoepiglottic fold, *4* aryepiglottic fold

The exposure of the anterior commissure also depends on the size of the angle between the two thyroid laminas: it is usually obtuse in females and in children, approximately a right angle in adult males.

Morgagni's ventricles can be explored with a dissecting forceps. These lie between the ventricular fold and the vocal cords that separate in depth the superior and inferior infraglottic spaces. By palpation we identify the arytenoid cartilages and the cuneiform and corniculate accessory cartilages (Fig. 9.22).

Remarks: In TNM staging, the arytenoid cartilages are a subsite of the supraglottis. However, it appears clear that the arytenoid cartilage is a structure that belongs both anatomically and functionally to the glottic region [1].

Up until now, we have examined the external conformation of the larynx. We shall now try to consider the paraglottic spaces and the structures that bound them. To do this, we remove the portion of the base of the tongue which is in front of the hyoid bone and also the piriform sinuses.

9.6 Inside the Larynx

First Step: At this point the perichondrium of the thyroid cartilage is incised along its superior margin and separated from the cartilage on both sides, arriving anteriorly at the anterior commissure and laterally at the bottom of the laryngeal ventricles (Fig. 9.23a).

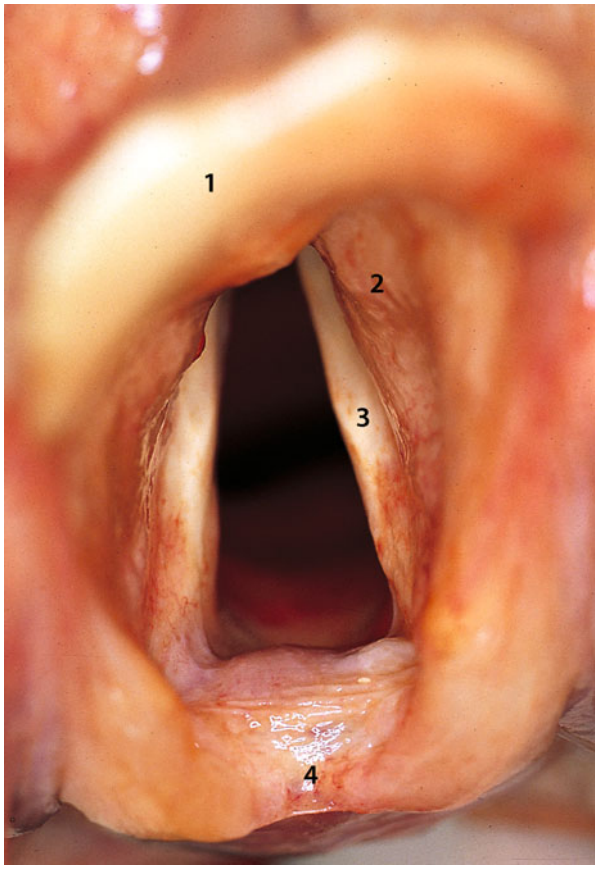

Fig. 9.18 Larynx: glottic plane. *1* Epiglottis, *2* ventricular fold, *3* vocal cord, *4* posterior commissure

Now we make a median sagittal incision which, starting from the tongue base, sections the hyoid bone in the centre and the epiglottis, dividing it in two halves, as far as the anterior commissure. We have thus exposed the adipose tissue of the preepiglottic space; we evaluate the conformation of the epiglottis cartilage and the consistency of the thyroepiglottic ligament (Fig. 9.23b).

We then section the aryepiglottic fold with forceps just in front of the arytenoid cartilage, proceeding in a craniocaudal direction, from its apex towards the vocal process. Then, straightening the forceps, we resect the mucosa of the bottom of the ventricle, until we arrive just up the anterior commissure. At this point we shall have removed the supraglottic larynx (mucosa, quadrangular membrane, submucosa, internal perichondrium) at one side (Fig. 9.23c).

Remarks: The laryngeal ventricle (Morgagni's ventricle) is no longer considered a subsite of TNM staging since it is considered to be formed by the inferior surface of the ventricular band and the superior surface of the vocal cord.

Second Step: We now consider the glottic plane. We grip the epithelium of the vocal cord with forceps near the anterior commissure and, pulling it medially and dissecting it with the scalpel, we expose the vocal ligament which appears as a thin

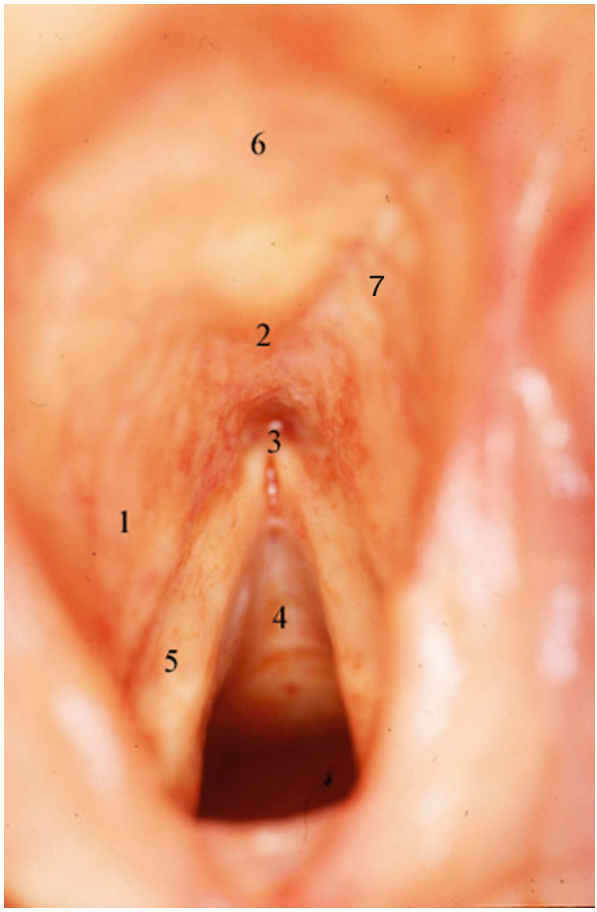

Fig. 9.19 Larynx: anterior glottis. *1* Right ventricular fold, *2* petiole of the epiglottis, *3* anterior commissure, *4* subglottis, *5* left vocal cord, *6* infrahyoid epiglottis, *7* laryngeal corner

fibrous tendon extending as far as the vocal process of the arytenoid cartilage. Laterally, the arytenoid cartilage presents instead a muscular process into which the vocal and cricoarytenoid muscles insert (Fig. 9.23d (1)).

Remarks: In so doing, we have reproduced what is normally called "peeling" or "decortication" or "stripping" of the vocal cord, that is, the removal of the epithelium and of the tunica propria (Reinke space), leaving the vocal ligament intact.

At the level of the anterior commissure, by palpation we can check that the mucosa is very close to the thyroid cartilage. In fact the submucosa is not represented in this site.

Remarks: This fact introduces various considerations on the endoscopic laser treatment of the neoplasias affecting the anterior commissure, since the distance that the tumour can travel to infiltrate the cartilage is really minimum.

For the sake of precision, we point out that the anterior commissure is conventionally defined as an area of mucosa interposed between the vocal cords, bounded superiorly by an imaginary line joining the corner of the ventricles and extending inferiorly for 3 mm [2].

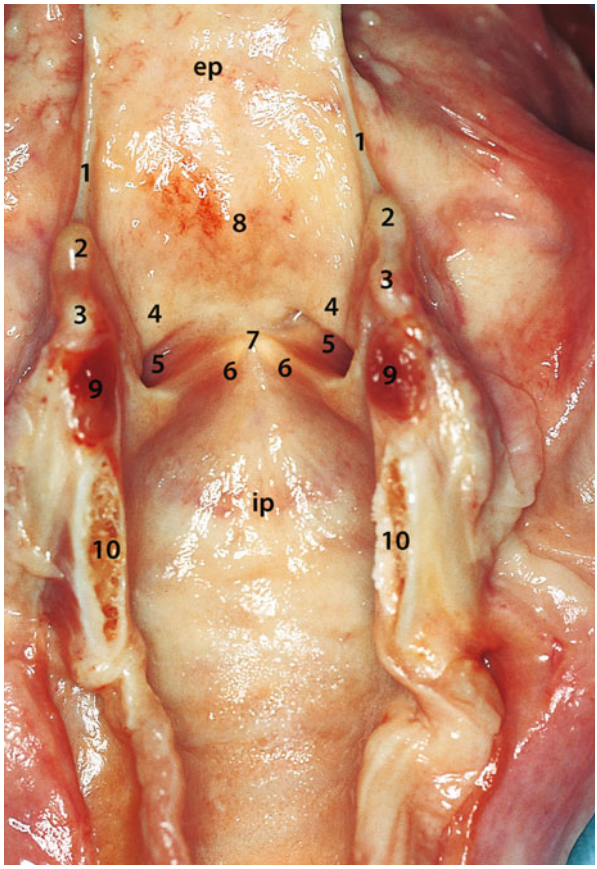

Fig. 9.20 Larynx and hypopharynx: intraluminal view (IV). *ep* Epiglottis, *ip* subglottis, *1* aryepiglottic fold, *2* cuneiform tubercle, *3* corniculate tubercle, *4* ventricular fold, *5* Morgagni's ventricle, *6* vocal cord, *7* anterior commissure, *8* petiole, *9* interarytenoid muscle, *10* cricoid lamina (sectioned)

Third Step: We section the vocal cord midway between the anterior commissure and the vocal process of the arytenoid cartilage, cutting down until we reach and interrupt the internal perichondrium. We observe and evaluate the five planes that we encounter in this section and remember that the stratification of the vocal cord is composed as follows: epithelium and tunica propria (or Reinke's space; together defined as the mucosa), vocal ligament, vocal muscle, submucosa (or inferior preepiglottic space), internal perichondrium, and finally thyroid cartilage (Fig. 9.23d (2)).

Remarks: The inferior limit of the glottis is conventionally established at 1 cm from the free edge of the vocal cord. This limit corresponds approximately to the point in which the elastic cone divides inferiorly into two components, one following the mucosa and the other enclosing the cartilage [1]. The attempt to have the glottic mucosa coincide with the pavement epithelium cannot be sustained because this covers the vocal cord with a maximum extent of 5 mm in its middle third and it is reduced, and often disappears, at the level of the anterior commissure.

Fourth Step: To conclude the dissection of this region, we transversely incise the cricothyroid membrane as in emergency tracheotomy (intercricothyroid laryngectomy).

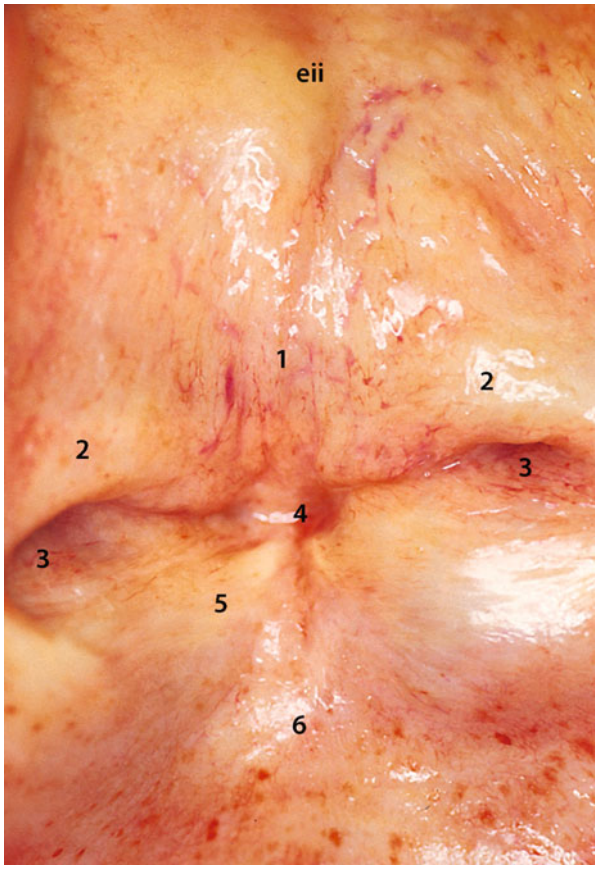

Fig. 9.21 Anterior commissure. *eii* Infrahyoid epiglottis, *1* petiole, *2* ventricular fold, *3* Morgagni's ventricle, *4* anterior commissure, *5* vocal cord, *6* subglottis

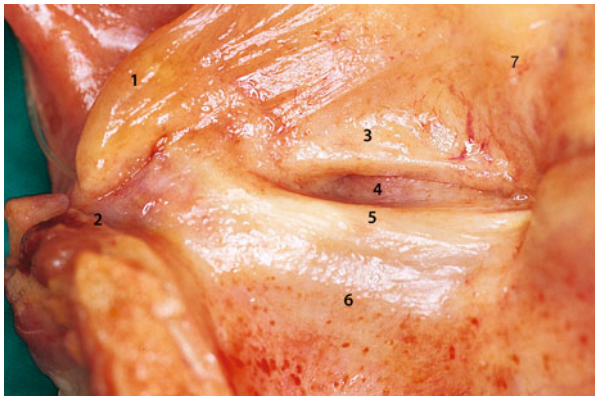

Fig. 9.22 Morgagni's ventricle. *1* Arytenoid cartilage, *2* posterior commissure, *3* ventricular fold, *4* Morgagni's ventricle, *5* vocal cord, *6* subglottis, *7* laryngeal corner

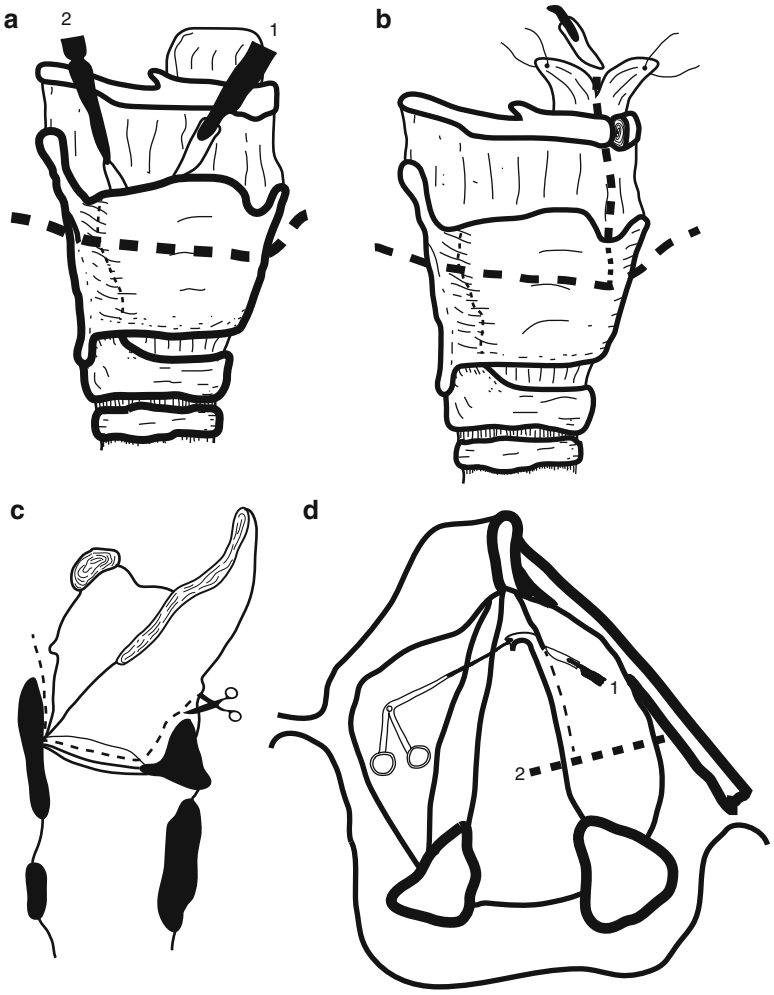

Fig. 9.23 Exeresis of the supraglottis, (**a**) *1* incision of the perichondrium, *2* its separation from thyroid cartilage (**b**) median sagittal incision (**c**) supraglottic horizontal hemilaryngectomy (**d**) *1* stripping of the epithelium, *2* section of the vocal cord

In this incision we may find the cricothyroid artery which comes from the lateral branch of the superior thyroid artery. Looking cranial into the lumen, we assess the distance between this surgical access and the glottic plane.

Remarks: Tracheotomy is carried out at this level in emergency situations where it is absolutely necessary to ventilate the patient in the shortest time possible. Once it is certain that the airways are controlled, the patient must be anaesthetised, and the tracheotomy must be moved more caudal, preferably under the thyroid isthmus. Tracheostomas that are too cranial invariably cause permanent stenosis of the subglottis.

Take-Home Messages

- The anatomo-pathological observation of the stratification of the vocal cord and clinical and surgical evaluations have led to new protocols for the treatment of tumours of this larynx subsite.
- The concept of functional surgery of the vocal cord was officially introduced in 2002 [3]. Considering that most glottic tumours do not go beyond the depth of the vocal ligament, it was deemed that the subperichondrial cordectomy systematically carried out for all T1a tumours was overtreatment in most cases. Endoscopic laser surgery takes this consideration into account and classifies cordectomies according to the depth of resection programmed for the various degrees of tumour infiltration. The result is a lower morbidity rate and often much less accentuated dysphonia.

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3. Remacle M, Eckel HE, Antonelli A et al (2000) Endoscopic cordectomy: a proposal for a classification by the Working Committee, European Laryngological Society. Eur Arch Otorhinolaryngol 257:227–231