Thesis

Prospective study "Quality analysis and risk assessment of microlaryngoscopy in outpatient setting".

submitted by

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in partial fulfillment of the requirements for the degree of

Doktor der gesamten Heilkunde

(Dr. med. univ.)

at the

Medical University of Graz

executed at the

University Clinic for Otorhinolaryngology

Department of Phoniatrics

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Graz, 05.03.2025

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Graz, 05.03.2025 *Lionel Balthasar Kilian Frank m.p.*

Acknowledgement

First of all, I would like to thank my supervisors Dr. med. univ. et scient. med. Hannaleena Tervonen and Univ.-Prof. Priv.-Doz. Dr. med. univ. et scient. med. Markus Gugatschka for the opportunity to write this thesis while also thanking them for their great supervision and support.

Thanks to Dr. rer. nat. Andrea Groselj-Strele for her guidance in statistical matters.

Special thanks go to my girlfriend Lisa, my mother Karin, my friend and study partner Andreas and my sister Fiona for their support during my studies.

Zusammenfassung

Einleitung

Mikrolaryngoskopische Operationen unter Allgemein-Anästhesie gelten allgemein als Eingriffe von kurzer Dauer und geringer Invasivität. Die international angegebenen Komplikationsraten liegen zwischen 1 % und 79 %. Da mikrolaryngoskopische Eingriffe als ausreichend sicher gelten, werden sie in Nordeuropa, Westeuropa, Kanada und den Vereinigten Staaten in der Regel ambulant durchgeführt. In Anbetracht dieser Fakten ist es relevant, die Komplikationsraten von mikrolaryngoskopischen Eingriffen sowie Vor- und Nachteile von ambulanten Eingriffen zu untersuchen, sowohl zur Qualitätskontrolle, als auch für den internationalen Vergleich mit dem Ziel der Risikobewertung für tagesklinisch-ambulante Eingriffe.

Materialien und Methoden

Insgesamt wurden konsekutive 100 Patient*innen, die an der Universitätsklinik Graz eine mikrolaryngoskopische Operation hatten, wurden, über den Zeitraum von einem Jahr rekrutiert. Das Kollektiv setzte sich aus 67 ambulanten und 33 stationären Eingriffen zusammen. Die Zuordnung zur Art des Eingriffs (ambulant oder stationär) erfolgte aufgrund der primären Diagnose, des Vorliegens von Komorbiditäten, oder anderer anästhesiologischer Gründe. Bei der Entlassung wurden Alter, Geschlecht, Operationsindikation, Operationsdauer, Name des Operateurs, Art des Eingriffs (ambulant/stationär), Schleimhautverletzungen im Kehlkopf und Rachen, Blutungen/Nachblutungen sowie Zahnschäden oder Zahnverluste dokumentiert. Bei einer postoperativen Kontrolle wurde das Auftreten weiterer Beschwerden und Komplikationen erfasst. Die Patienten, die sich nach der Operation einer ambulanten Behandlung unterzogen, wurden außerdem gebeten, bei beiden Terminen ihre Zufriedenheit mit dem ambulanten Eingriff zu bewerten.

Ergebnisse

Die Komplikationsrate lag bei 5,4 % (2% Schleimhautverletzungen, 3,4% andere postoperative Komplikationen), die subjektive Beschwerdefreiheit an beiden Untersuchungsterminen betrug 86,3 % und die Patientenzufriedenheit war sowohl bei der Entlassung als auch bei der Nachuntersuchung hoch (97 % und 94,5 %).

Diskussion

Diese Studie legt nahe, dass viele mikrolaryngoskopische Eingriffe erfolgreich in den tagesklinisch-ambulanten Bereich verlagert werden können. Bedenken hinsichtlich der Qualität und Sicherheit solcher Eingriffe stammen aus der älteren Literatur und wurden in neueren Studien weder geäußert noch repliziert. Unabhängig von diesen Bedenken zeigt diese Studie aber auch, dass die Zufriedenheit der Patienten mit tagesklinisch-ambulanten Eingriffen hoch ist.

Abstract

Introduction

Microlaryngoscopic surgery under general anesthesia is generally considered generally to be a procedure of short duration and low degree of invasiveness. Complication rates reported in the international literature are ranging from 1% to 79%. Because microlaryngoscopic surgeries are considered to be sufficiently safe they are usually performed on outpatient basis in Northern Europe, Western Europe, Canada and the United States.

As microlaryngoscopic surgery is considered sufficiently safe, it is generally performed on an outpatient basis in Northern Europe, Western Europe, Canada and the United States. In view of these facts, it is relevant to investigate the complication rates of microlaryngoscopic procedures and the advantages and disadvantages of outpatient procedures, both for quality control and for international comparison with the aim of risk assessment for outpatient procedures.

Materials and Methods

A total of 100 consecutive patients who underwent microlaryngoscopic surgery at the university clinic of Graz were recruited over the span of one year. The collective consisted of 67 outpatient and 33 inpatient procedures. The allocation to type of procedure (inpatient or outpatient) was based on primary diagnosis, the presence of comorbidities and other anesthesiologic reasons.

Age, sex, indication for surgery, duration of surgery, name of the surgeon, type of procedure (outpatient/inpatient), mucosal injuries in the larynx and pharynx, bleeding/postoperative bleeding, and dental damage or loss of teeth were documented at time of discharge. The occurrence of further complaints and complications was recorded during a post-operative check-up. The patients who underwent outpatient treatment after surgery were also asked to rate their satisfaction with the outpatient procedure at both appointments.

Results

The complication rate was found to be 5.4% (2% mucosal injuries, 3.4% other postoperative complications), subjective complaints on both examination dates were absent in 86.3% of cases and a high level of patient satisfaction both at the time of discharge and at the time of follow-up (97% and 94.5%).

Discussion

This study suggests that many microlaryngoscopic procedures can be successfully transitioned to an outpatient basis. Concerns regarding the quality and safety of outpatient procedures stem from old literatures and have not been raised or been replicated by recent studies. Beyond these concerns, this study also shows that there is a high level of patient satisfaction with outpatient surgery.

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1 Introduction

The term microlaryngoscopic surgery describes surgical and diagnostic procedures using a laryngoscope and magnification of the larynx (1), which are generally of short duration and low degree of invasiveness. (2) In general, microlaryngoscopic procedures are considered safe and have few serious complications. (2) Complication rates reported in the international literature are ranging from 1% (3) to 79% (4).

In studies conducted in the 1970s and 1980s, postoperative complications related to intubation were reported to be significantly higher in microlaryngoscopy patients compared to other procedures. (3, 5) As a result of these studies, it was recommended that microlaryngoscopy patients be admitted for clinical monitoring for 24 hours. (3, 5) Nowadays, however, due to microlaryngoscopic procedures being considered sufficiently safe and low in complications, they are usually performed on outpatient basis in the United States of America. (3)

In general, international comparisons clearly show that outpatient procedures are performed much more frequently in other healthcare systems, such as in Northern Europe, Western Europe, Canada and the United States, than in Austria. (6)

In view of these data and facts, it is relevant to examine complication rates of microlaryngoscopic procedures as well as the advantages and disadvantages of outpatient procedures in this area, both for quality review and comparison with the international literature and for risk assessment for outpatient procedures.

2 Anatomy of the larynx

The larynx is an organ which is suspended mobile on the hyoid bone at the level of the 3rd to 5th cervical vertebrae between the lamina prevertebralis and the lamina pretrachialis fasciae cervicalis and forms a cartilaginous-muscular occlusive system at the border of the alimentary and respiratory tracts. It is used for respiration, phonation and mechanical protection. (7)

The larynx is structured as a functionally stable system of articulating cartilage plates, which is subdivided into the supraglottic space, the transglottic space and the infraglottic space. This subdivision is made roughly by the plicae vestibulares and the plicae vocales, both pairs of mucosal folds of the larynx. (7)

The laryngeal skeleton is made up of four large and three small cartilages (epiglottis, cartilago thyroidea, cartilago cricoidea, cartilago arytenoidea (pair), cartilago corniculata (pair), cartilago cuneiformis (pair) and cartilago triticea), which form two articulations (articulatio cricothyroidea and articulatio cricoarytenoidea). (7)

The large cartilages of the epiglottis, cartilago thyroidea, cartilago cricoidea and the two cartilago arytenoidea are of primary functional importance. (7)

Laryngoscopically, the epiglottis, the vestibulum, the vestibular plicae, the vocal plicae and the arytenoid cartilages are well assessable visually. (7)

The larynx receives sensory, motor and parasympathetic innervation from two branches of the vagus nerve: The superior laryngeal nerve innervates the mucous membrane above the glottis with its ramus internus and the cricothyroid muscle with its ramus externus. The superior laryngeal nerve also sensitively innervates the glands of the folds of the pharynx. The recurrent laryngeal nerve innervates all internal muscles motorically, the mucous membrane below the glottis sensitively and the upper tracheal glands parasympathetically. (7)

3 Basics and principles of microlaryngoscopy

3.1 Definition and origin

Microlaryngoscopy refers to surgical and diagnostic procedures in the larynx with the aid of a laryngoscope and magnification using a surgical microscope. The terms suspension laryngoscopy and direct laryngoscopy are sometimes used synonymously in the literature. (1)

Microlaryngoscopic procedures are considered to have a short duration of surgery, a low degree of invasiveness (limited to a small portion of the mucosa) and are considered safe with a low likelihood of serious complications when compared to other surgical procedures. (2)

The origins of microlaryngoscopy as it is practiced today can be found in the works of Killian, who first described performing surgical procedures of the vocal cord with the aid of a hard laryngoscope, and Kirstein, who introduced the concept of suspension laryngoscopy and thus a surgical technique that allows bimanual instrumentation of the surgical field by the surgeon.(2, 9) Kleinsasser further refined the surgical technique and contributed to the widespread implementation of microlaryngoscopy both by developing modern laryngoscopes and laryngoscope holders and by establishing microlaryngoscopic procedures under general anesthesia.(2, 9) Microlaryngoscopy perfected by Kleinsasser allows a three-dimensional, magnified and well illuminated view. As a consequence, mucosal defects and alterations can be better and more precisely detected and surgically treated.(10)

Strong and Jako established microlaryngoscopy as a surgical procedure for resection of tumors of the larynx with maximum sparing of the laryngeal anatomy. (11)

3.2 Procedure

For better visibility, the patient's head is stretched and the mandible is raised.(2)

There are two techniques which have become established for achieving the desired head position: The suspension gallows technique introduced by Kirstein and the fulcrum technique developed later by Brünings (which is described in the literature as less complicated and associated with fewer complications). (9)

The head is then placed on a support (for example the headrest after Haslinger). (9)

A rigid direct laryngoscope is then inserted orally compressing the tongue and its base. The laryngoscope is then further inserted through the oropharynx into the hypopharynx to just

above the glottis. For better viewing, the head is hyperextended and the mandible is elevated.(1, 2)

After the laryngoscope is positioned, it is attached to a holder (according to the technique developed by Kleinsasser). (9)

The use of a microscope allows for a magnified view of the vocal cords.(2)

Thus the surgeon to view and operate on the larynx under a well illuminated and magnified view.(10)

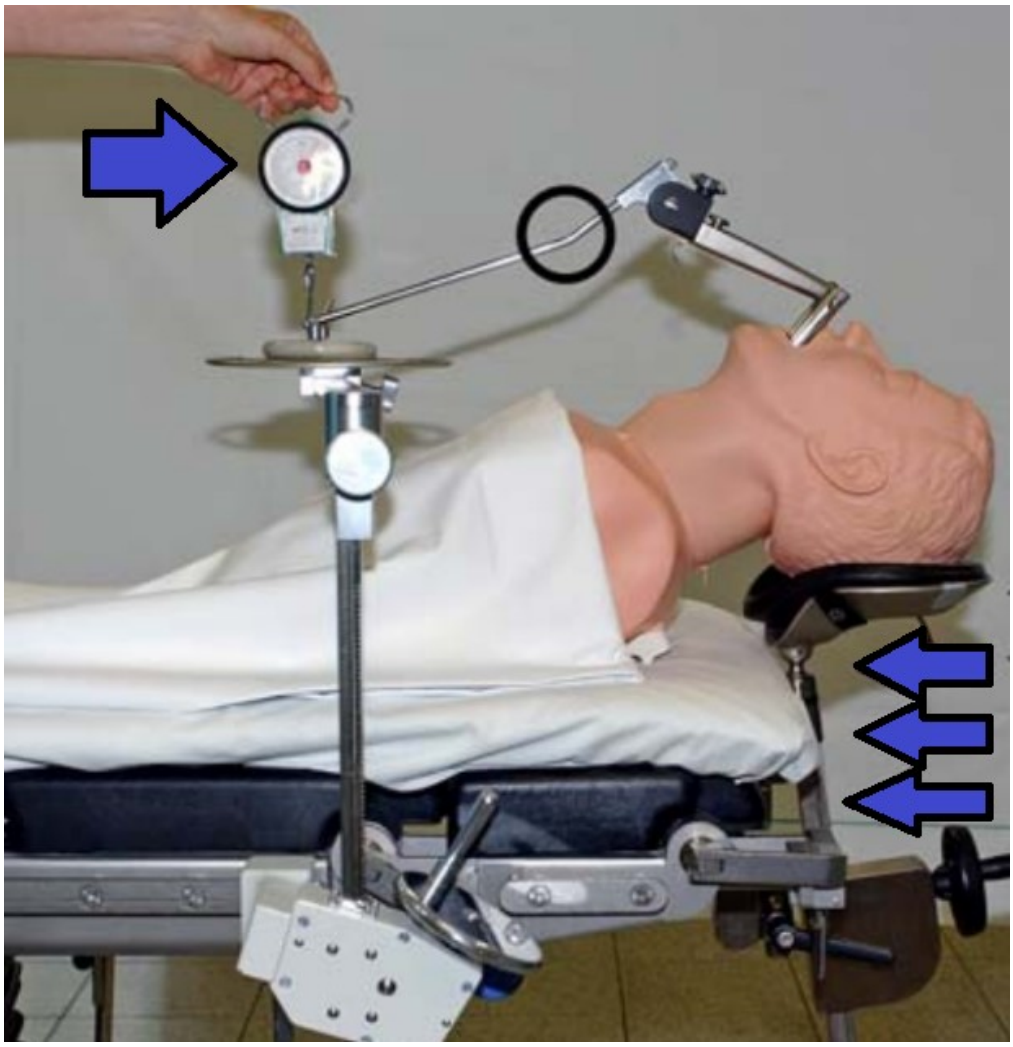

Figure 1: Setting during microlaryngoscopy. (1)

3.3 Use and observed pathologies

Microlaryngoscopic procedures generally have a relatively short time requirement of usually a few minutes to 30 minutes (2) and can be performed for diagnostic purposes (assessment and/or sampling) or as part of a larger transoral surgery.(8)

It should be mentioned, however, that complex phonomicosurgical procedures, which have become possible due to improvements in instrumentation, require a prolonged operative time compared to early and standard microlaryngoscopic procedures. (12)

Microlaryngoscopic procedures as a surgical tool allow the performance of incisions, excisions, dissections, augmentations, injections (in case of atrophy or paralysis of the vocal folds), implantations, vaporization, coagulation, injection of pharmaceuticals, aspiration, stenting, and mobilization.(2, 13)

The establishment of microlaryngoscopy brought a number of benefits in tumor surgery and surgery of the larynx in general and allowed for surgery's previously thought to be impossible: (11, 14)
Compared to the interventions formerly performed for carcinoma of the glottis (radiotherapy and partial or total laryngectomy), serious complications such as damage to other organs, damage to the spinal cord, and gastrostomy (due to schooling problems) can be avoided.(11)
Incision of the neck for vocal fold procedures with all the associated complications has also been made obsolete by microlaryngoscopy and its minimally invasive transoral approach. (15, 16)
In contrast to older treatment options for laryngeal tumors such as radiotherapy microlaryngoscopy can be repeated in a short timeframe if necessary (e.g., for residual tumors). (11)
Combination with laser surgery as a surgical technique is possible and often performed. (2, 16) These laser surgical procedures create better conditions for organ-preserving tumor surgery of the larynx. (4)
The use of an operating microscope significantly improves the early detection of laryngeal carcinoma. (4)

Microlaryngoscopy has also opened up previously impossible diagnostic alternatives: (14)
Microlaryngoscopy is more direct and reliable for detecting lesions, malformations, or associated lesions than direct or conventional indirect laryngoscopy. (10)
As shown in a study by Lehmann et al., where microlaryngoscopy and histology were concordant in 91.5% of cases. (10)
Because the vocal cords are small organs (15-20mm in men and 9-13mm in women), there are significant advantages in terms of precision of procedures from using a surgical microscope that provides a binocular view. (2)

The most common laryngeal pathologies which are be treated via microlaryngoscopy include polyps, hyperplastic chronic laryngitis, Reinke's edema, and laryngeal squamous cell carcinoma. (10)
Other common pathologies include: Keratosis, cysts, glottic sulcus, nodules, nonspecific granulomas, juvenile papillomatosis, hyperkeratotic papilloma. (10)
Rare pathologies include: Laryngocele, angiomas, laryngeal tuberculosis, Wegener's granulomatosis, amyloid tumors. (10)
Lehmann et al described a frequency distribution of (56.5%) benign pathologies as the most common entities, premalignant findings (chronic laryngitis, hyperkeratotic lesions, hyperkeratotic papilloma with or without dysplasia) as the second most common entities (29.8%), and malignant findings as the least common entities (13.7%). (10)
In their 7743-case study, Orosco et al. reported the indications for performing MLX with the following percentage distribution: Other vocal fold disease at 17.7%, vocal fold polyp at 8.7%, malignant neoplasm of the glottis at 6.9%, malignant neoplasm of the base of the tongue at 5.6%, and benign neoplasm of the larynx at 5.4%.(3)

4 Complications

4.1 Rates of complications

The complication rate of microlaryngoscopic procedures has been reported in different studies, which found a totality of possible complications in a very wide range from 1%(3) to 79%(4). Common complications of microlaryngoscopy include cellular damage, mucosal lesions (oropharyngeal and laryngeal), nerve lesions (hypoglossal nerve, lingual nerve, recurrent laryngeal nerve), functional disorders of the temporomandibular and upper cervical joints, dental dislocations, and serious cardiac complications (arrhythmias and myocardial ischemia). (4, 17)
It should however be noted, that in studies describing high complication rates, these number consists almost exclusively of minor complications. Furthermore, most complications associated with microlaryngoscopy have a very low morbidity and can be avoided by good surgical technique. (14)
The following studies regarding the outcome of complications after and due to microlaryngoscopic procedures have been performed since the 1970s (in ascending order by year of publication):

Reference	Study (name and date)	Authors	Complication rate
(18)	Side-effects and complications following suspension laryngoscopy, 1976	Heiden C, Westhues M, Kornmesser HJ	4,5% total
(5)	Admission planning and complications of direct laryngoscopy, 1994	Hendrix RA, Ferouz A, Bacon CK	19.5% severe 21% mild
(4)	The incidence of microlaryngoscopy associated complications, 2002	Muller A, Verges L, Schleier P, Wohlfarth M, Gottschall R	79% total 0% severe 11% moderate 68% mild complications
(12)	Oropharyngeal complications of suspension laryngoscopy: a prospective study, 2005	Rosen CA, Andrade Filho PA, Scheffel L, Buckmire R.	0% severe 37.5% mild
(14)	Extra-laryngeal complications of suspension laryngoscopy. Braz J Otorhinolaryngol. 2007	Dos Anjos Corvo MA, Inacio A, de Campos Mello MB, Alessandra Eckley C, Campos Duprat A.	72.9% total
(9)	Analysis of forces applied during microlaryngoscopy: a descriptive study, 2008	Gugatschka M, Gerstenberger C, Friedrich G.	0% total
(3)	Safety of Adult Ambulatory Direct Laryngoscopy: Revisits and Complications, 2015	Orosco RK, Lin HW, Bhattacharyya N.	0.42% severe 0.75% mild
(11)	Complications after CO2 laser surgery for early glottic cancer: An institutional experience, 2016	Lee M, Buchanan MA, Riffat F, Palme CE.	0,5% severe 1.5% mild 22% mild complications occurring later
(8)	Direct Microlaryngoscopy: A Population-Based Analysis on Outcome, Complications and Surgery Rates, 2017	Grafe L, Boger D, Buntzel J, Esser D, Hoffmann K, Jecker P, et al.	23,2% total
(19)	Consistent Technique Limits Suspension Laryngoscopy Complications, 2019	Larner SP, Fornelli RA, Griffith SD.	3.8% total
(2)	Complaints and Complications of Microlaryngoscopic Surgery, 2020	Okui A, Konomi U, Watanabe Y.	66% total

Table 1: Complication rates described in international literature

4.2 Etiology and risk factors for complications during and after microlaryngoscopy

Since microlaryngoscopic procedures on the vocal cords rely on suspension of the laryngoscope, understanding the risks and possible complications is equally important to the surgeons treatment plan and the patients ability to give informed consent.(12) Most complications associated with microlaryngoscopy are mild but have a significant

temporary impact on the patient's quality of life. Therefore, they should be avoided as much as possible. (15)

Upper airway manipulation is essential for the performance of microlaryngoscopy. (3) As a consequence of these manipulations the upper airway may be compromised due to laryngospasm, laryngeal edema, hemorrhage, and other complications may occur. (3) Adequate visualization of endolaryngeal structures during microlaryngoscopy requires the application of pressure to the oropharyngeal and pharyngeal tissues. (9) The application of pressure to these tissues can lead to traumatic complications such as tooth fractures, hematomas, swelling, mucosal injury, hemorrhage, and nerve damage (especially to the n. hypoglossal nerve). The force required depends on variables such as individual anatomy, sex, age, type and size of laryngoscope, insertion technique and positioning of the patient. (9)
Especially when good visualization of the anterior commissure is required, a high force is needed to adjust the target structures. As a consequence of this same force application, complications such as instrument-related tissue damage and cardiovascular reactions in terms of hypertension and tachycardia may occur. (4)

Friedrich and Gugatschka showed that the head position of patients has a significant effect on the setting of relevant anatomical structures. Consequently, both the ease of good exposure of the anteriorly located portions of the glottis and the force required depend on the patient's head position. With maximal elevation, the anterior commissure could always be adjusted and, in contrast, with maximal extension of the cervical spine, it could not be visualized even with maximal force application. Elevation of the head in combination with flexion of the cervical spine is always beneficial in this regard - the degree of flexion (moderate vs. maximal) is not statistically significant. (13)
Feng et al. were also able to show that increased force in the form of pressure exerted by the laryngoscope is a significant predictive parameter for the development of postoperative complications. (20)

The mean force to be applied on the patient's chest, tongue, and teeth to insert the microlaryngoscope and visualize relevant structures measured by Gugatschka et al. was 43.1 N ± 14.7 N (4.4 kg ± 1.5) with a minimum of 10.8 N (1.1 kg) and a maximum of 87.3 N (8.9kg). The use of larger laryngoscopes increases the force required to adequately

expose the target structures. However, this higher amount of force required was not found to be statistically significant. There is no statistically significant relationship between laryngoscope size and ease of exposure of relevant structures. The subjective feeling of the surgeon allows for a good estimate of whether a high or low amount of force is being applied and whether this grade of force necessary. (9)

In 2015, Orosco et al. pointed out that laryngeal manipulation has become easier, better, and safer in practice over the years. This is mainly due to an improvement in surgical instruments (additions for endoscopes, etc.). The principles of technical performance have essentially remained the same. (3)
Longer operative time was found to be a risk factor for higher complication rates by both Gräfe et al. and Tessema et al. (8, 21) Rosen et al. also found a correlation between the duration of the procedure and the size of the laryngoscope regarding the development of mild oropharyngeal complications. (12)
Also of note, many patients requiring microlaryngeal surgery have a medical history of cigarette and/or alcohol abuse and cardiovascular disease. (22)

The female sex may also be a positive predictive parameter for the occurrence of complications after microlaryngoscopic procedures. For instance, Tessema et al found significantly higher complications rates for paresis and dysgeusia in female patients. (21) Feng and Song also found the female sex to be a possible risk factor for tongue complications. (15) Okui et al. described a higher incidence of "sore throat" as a postoperative complication in women but could not find a higher incidence of tongue-related complications in women. (2)

It is important to note that some complications such as mucosal lesions are not limited to the surgical procedure of microlaryngoscopy - they can usually develop (caused by intubation) 1-2 hours after extubation. (2) Intubation-related complications are of particular concern, as the rate of "difficult endotracheal intubation" in patients with ear otorhinolaryngological carcinoma surgery can be as high as 16%, approximately six times higher than the rate in the population of general surgery patients. (22)
Also, conditions such as sore throat that are found in some studies are not necessarily due to the surgical microlaryngoscopic procedure but may also represent a temporary persistence of preexisting sore throat. (19)

4.3 Laryngeal edema

Gräfe et al. described transient laryngeal edema as the most common complication in their study with an incidence of 22%. Furthermore, they could show that a longer operation time is an independent predictive parameter for postoperative bleeding or laryngeal edema. (8)
Another study by Müller et al. did not find severe laryngeal edema. In their study, mild edema also represented one of the more common minor complications. (4)
It is worth noting that laryngeal edema usually develops within 1-2 hours after extubation, caused by intubation, and thus cannot be solely attributed to complications of to the microlaryngoscopic surgical procedure.(2)

4.4 Bleeding

Bleeding requiring revision is a rare but significant complication. (8)
If reported the incidence of bleeding is usually low. Gräfe et al described at rate of 1%(8), Okui et al described a rate of postoperative bleeding of 0.18%(2), Lee et al found no postoperative rebleeding in their study (looking only at glottic tumor laser resection),(11) and Klussmann et al. described a bleeding rate of 7% in their study(23). The Rate reported by Klussmann however refers to all forms of bleeding and not exclusively bleeding requiring revision. (8, 23)

4.5 Dental damage

The force exerted via the "lever" of the microlaryngoscope can primarily result in enamel chipping, tooth fractures and tooth luxation or secondarily in obliteration of the pulp cavity. Upper tooth damage in particular can be caused by the lever-shaped design of the microlaryngoscope. The danger increased by the lever effect is due to the circumstance that the dental apparatus can only tolerate a low transversal force effect. (4)
Dental damage as a complication of microlaryngoscopic procedures was reported to be 1% by Gräfe et al. The authors explain these small rates by the consistent use of a dental protector.(8) Klussmann et al. found tooth damage in a total of 6.5% of patients these were described in a total of 6.8% of therapeutic procedures and 6.0% of diagnostic procedures. (23) The tooth damage described by Klussmann et al. had a highly significant correlation with preoperative dental disease ($p < 0.04$) and periodontitis ($p < 0.001$). (23) Rosen et al. described no tooth damage in their study. In their study, 84.9% of patients had preoperative dental status without abnormalities. (12) Okui et al. described tooth damage at a rate of 0.9%. (2) Müller et al. described the rate of tooth damage as 2.5%. (4)

The incidence of dental damage reported in different studies during microlaryngoscopic procedures varies depending on the experience of the surgeon, the methodology of each study, criteria for defining dental damage, the preoperative dental status of the patient, and the suspension technique used. (22)
The number of unreported cases of tooth damage may be significantly higher than indicated in the literature, as visually invisible damage such as sprains and intra-alveolar fractures are not seen and are not immediately noticed by the patient. (4)
The likelihood of dental damage can be reduced by dental protection, individual reclination of the head, and well controlled muscle relaxation. (4)
Simple exposure of relevant target structures is much easier in the absence of teeth. (9)

4.6 Small damages of the mucosa

Damage to the mucosa is the most commonly described complication of microlaryngoscopic procedures in studies that record them. They include hematomas, edema of the soft tissue, and incisions. They resolve in a short time via restitutio ad integrum. (14)
Consequently, small damages of the mucosa, as they heal very fast and well, can only be detected and described in studies in which document complications early (1-day post-op). If the complications are recorded after one week post operation or later they have already completely healed and can therefore not be detected. (19)
Klussmann et al. described small damages of the mucosa in 75% of the patients – all healing spontaneously and within a few days. (23)
The incidence and duration to healing of complications caused by mucosal lesions are similar to those associated with endotracheal intubation. Thus, it is possible that these complications are not simply caused by MLX but may be entirely due to intubation. (2)

4.7 Nerve lesions

4.7.1 Nerve lesions in general

Nerve lesions - more precisely lesions of the hypoglossal nerve, the lingual nerve and the recurrent laryngeal nerve - are recorded and documented in many studies. (4)
Documentation occurs partly subdivided into the respective nerves involved (2, 4, 14, 24), and partly described more generally as "complications of the tongue" (15, 16, 21, 25).
In general, the etiology of damage to the hypoglossal nerve and the lingual nerve is due to pressure on the lateral margin of the tongue. Ossification of the stylohyoid ligament may

also promote lesion of these nerves. (4) Ischemia is also described as a primary characteristic in stretch-related nerve damage. Consequently, shorter procedures and the concomitant shortened ischemia time may reduce the risk of complications. (19, 24) The rarity of nerve lesions during microlaryngoscopic procedures points to multifactorial causes (both anatomic and surgical factors). (14)

Symptomatically, nerve damage manifests as mostly temporary sensory deficits (24), sensory alterations of the tongue (19), and taste alterations (19).

Nerve lesions due to microlaryngoscopy are transient in almost every case. (12, 21, 24) If they occur, the prognosis is generally excellent. (24)

In most cases, nerve damage accounts for a very small to nonexistent portion of the overall documented complications. (4) For example, both Gugatschka et al (9) and Müller et al (4) were unable to document any nerve damage in their respective studies. Müller et al attributed this to consistent adjustment of the larynx over the base of the tongue in tubus-free jet ventilation. (4)

However, other studies could observe nerve damage as a complication:

Rosen et al. described minor changes in the gustatory sense in 18%, subjective dysphagia in 16%, and numbness of the tongue in 12.5% of cases. The recovery time was reported to be 11 days on average and 6-34 days in absolute terms with complete recovery of all patients. (12)

Dos Anjos Corvo et al. detailed a complication rate of 13.5% nerve damages (2.7% complete alteration of tongue movement, 5.4% decreased sense of taste, 2.7% paralysis of the tongue and decreased sense of taste. 2.7% paralysis of the tongue). (14)

Temporary nerve lesions were detected in 3.8% of cases by Klussmann et al. and were divided into temporary damage to the lingual nerve, 2.7%, and temporary damage to the hypoglossal nerve, 1.1%. (23)

In general, damage to the lingual nerve seems more likely than damage to the hypoglossal nerve. (2)

4.7.2 Complications of the tongue

In their study on paresis and dysgeusia of the tongue after microlaryngoscopy, Tessema et al. described an initial rate of 15% of patients with paresis of the tongue and 3% with dysgeusia. However, the number of symptomatic patients decreased to a total of 4% after one month and 1% after three months, without any further therapeutic intervention. Tessema et al further observed that a surgical duration of more than one hour was

associated with an almost fourfold increased risk of tongue paresis relative to patients with a surgical duration of less than 30 minutes. Yet, this observation was not statistically significant. (21)

Feng and Song reported a 36% complication rate for tongue-related complications (defined as dysgeusia, pain, paresthesia, paresis). Applied force and female sex were found to be predictive parameters for tongue complications. (15)

In their study, Tomofuji et al. found evidence for taste disturbances and pain of the tongue in only one out of 35 patients in the microlaryngoscopy group. (16) It is also important to mention that in this patient, the neck was not extended during the procedure for laryngoscope insertion (16) which will have resulted in increased force application and poorer visualization of the target structures during surgery (9, 15). This patient also recovered completely within 3 weeks. (16)

Okui described numbness of the tongue in 13.8% and disturbances of the sense of taste in 4.4%. These complications require a mean of 4 days for complete recovery. However, it should also be noted that 25% of patients with taste disturbances and 21% of patients with numbness of the tongue required more than 2 months for complete recovery. (2)

4.7.3 Complications of the hypoglossal nerve

Damage to the hypoglossal nerve can lead to motor symptoms and possibly alterations in sensitivity of the tongue. (14)

According to older literature, the rate of damage to the hypoglossal nerve is up to 4%. The majority of paresis described was reversible in 4-8 weeks. (4)

In the more recent literature, Okui et al. described a rate of 0.4% for lesions of the hypoglossal nerve, in contrast to the high rate mentioned above. These were all temporary and healed completely after 39 days. (2)

4.7.4 Complications of the lingual nerve

The lingual nerve is responsible for ipsilateral sensory innervation of the tongue, lower gums, and floor of the mouth. Furthermore, it is responsible for the sense of taste in the anterior 2/3 of the tongue through its corda tympani branch and the parasympathetic innervation of the glandula submandibularis. (14)

Consequently, lesion of the lingual nerve will result in sensory disturbance and paralysis of the innervation area. (14)

Mechanisms described by which the lingual nerve could be damaged during microlaryngoscopic procedures are: direct pressure through the laryngoscope on the nerve,

stretching of the nerve by pressure exerted by the cricoid or by instrumentation, compression of the nerve between the medial and lateral pterygoid by manipulation of the mandible. (24)

Since the complication rate of lingual nerve injury caused by intubation is approximately 0.06% according to the literature and rate of lingual nerve damage during microlaryngoscopy is 2.7% (23), it can be assumed that most of the damage to the lingual nerve during microlaryngoscopic procedures is caused by microlaryngoscopy itself and not intubation. (2)

4.8 Laryngospasm

Laryngospasms can be induced during microlaryngoscopic procedures by afferent stimulation of the internal branch of the laryngeal nerve, causing reflex spasm of the glottic adductor leading to upper airway obstruction. (2)

The probability of laryngospasm under general anesthesia has been reported to be 1%. (2) There is no precise data on the incidence of laryngospasm during microlaryngoscopy but rather isolated reports of laryngospasm occurring as a rare complication. (2)

4.9 Cardiac complications

Reports of serious cardiac complications such as arrhythmias and myocardial damage, as shown in older literature, no longer appear in more recent literature. (4)

Whereas moderate cardiac complications in the sense of an increase/decrease in mean arterial pressure or heart rate by more than 50% were found by Müller et al in 8.6% of patients. Mild cardiac complications in the sense of an increase/decrease in mean arterial pressure or heart rate of more than 30% were found in 14.8% of patients in the same study, and mild cardiovascular reactions in combination with tissue damage were found in 28.4% of patients. However, all of these did not entail subsequent cardiovascular damage. (4)

4.10 Tongue edema

Severe tongue edema is a complication of microlaryngoscopic procedures first described in recent literature. Lafferty et al. reported 2 cases in which tongue edema developed during prolonged microlaryngoscopic procedures (247 min and 224 min). These edemas were self-limiting and resolved within a few days under observation and with the administration of corticosteroids. (26) The authors hypothesized that the etiology of tongue edema may lie in the long operative time coupled with prolonged and large force application to the tongue and recommended monitoring of such patients. (26)

Onal et al. also demonstrated tongue edema as a complication after microlaryngoscopy via ultrasonography. Onal et al. consider the cause of the tongue edema they describe to be an ischemic reperfusion injury after pressure exerted through a laryngoscope. (27)
In the context of severe tongue edema swelling and airway obstruction can occur which is why hospitalization is considered to be necessary in these cases. (26)

4.11 Preventive measures to reduce complications

Although most complications of microlaryngoscopy are minor, they have a significant temporary impact on the quality of life of patients. Therefore, they should be avoided as much as possible. (15)
The majority of the complications mentioned above can be attributed, at least in part, to the application of pressure through the laryngoscope. Consequently, it stands to reason that reducing the force applied for insertion and positioning of the laryngoscope is a good way to prevent the common complications of microlaryngoscopy that result from pressure-induced tissue trauma. (9, 25)
Intraoperative monitoring of applied force can be used as a tool to prevent complications.(20) Feng et al demonstrated that intraoperative monitoring of the pressure applied to the patient's oropharynx can predict complications such as tongue pain, paresthesias, paresis, and dysgeusia. (20) Reducing the applied pressure by having the surgeon respond to intraoperative monitoring can reduce the complication rate by avoiding unnecessarily high pressure and the associated reduction in maximum applied force. (20)
Microsurgical sutures in microlaryngoscopic procedures that cause a mucosal defect result in primary rather than secondary healing of the defect, which leads to faster wind healing but not to an improvement of the postoperative outcome. (28) In patients who require phonation in their professional life (such as singers), this technique may be preferable because of faster healing. (28) The larger the defect in the mucosa - for example, in surgery for Reinke's edema and broad-based polyps of the vocal folds - the more likely microsurgical suturing is to be considered to speed healing during surgery. (28)
Larner et al. attributed their very low complication rate of 3.8% to the use of a mouth guard, protection of the oral mucosa, and a surgical time limited to less than 30 minutes. (19)
Since a longer operation time also correlates with an increased incidence of complications, it is advantageous to keep microlaryngoscopic procedures as short as possible. (19, 21)

5 Materials and Methods

Prior to the start of data collection, the Ethics Committee of the Medical University of Graz approved the study.

For this study, a questionnaire was used which was completed by the doctor treating the patient at two points of time (immediately postoperatively and at a postoperative follow-up examination). The aim of this study was to obtain a total of 100 patients. The questionnaire was developed by Dr. Tervonen in cooperation with PD Dr. Sendlhofer (head of the QM-RM department at the University Hospital Graz).

The physician recorded the age, sex, indication for surgery, duration of surgery, name of the surgeon, procedure (outpatient/inpatient), mucosal injuries in the larynx and pharynx, bleeding/postoperative bleeding, and dental damage or loss of teeth on discharge. During the postoperative checkup, the occurrence of further complaints and complications was recorded by the doctor.

The study was deliberately not restricted to specific surgeons. Surgeries performed by assistants, young specialists in additional specialist training and experienced phoniatrics surgeons were all included in the survey.

The patients were questioned at both times (immediately postoperatively and at a postoperative follow-up examination if needed) regarding pain, swallowing difficulties, sensory, movement or taste disorders in the tongue area, temporomandibular joint problems, hoarseness, shortness of breath and other accompanying symptoms.

Patients who underwent outpatient treatment were also asked to rank their satisfaction with outpatient treatment at both appointments.

After reaching the planned 100 patients, the collected data were analyzed using the SPSS statistical software.

5.1 Inclusion criteria

The inclusion criteria were defined as follows: All patients undergoing a microlaryngoscopic surgery by the clinical division of phoniatrics with an existing indication for such a procedure and who were willing to complete the survey questionnaire.

5.2 Statistics

Statistical analysis and graphical presentation of the results using boxplots, histograms, tables, pie charts and bar charts were performed using the statistical program IBM SPSS Statistics 28.

The data collected as part of the study were descriptively analyzed, and the mean value and standard deviation were applicable.
In addition to the variables recorded in the questionnaire, the new variable "follow-up" (duration between discharge and follow-up examination) was calculated from the recorded dates.
For further analysis, the inpatient and outpatient groups were compared. For this purpose, ordinal-scaled variables (pain, swallowing difficulties, sensory, movement, or taste disorders in the tongue area, temporomandibular joint problems, hoarseness, shortness of breath, and other accompanying symptoms) were compared using the Mann-Whitney-U test. The metrically scaled variables (follow-up and duration of surgery) were tested for normal distribution using the Kolmogorov-Smirnov test and Shapiro-Wilk test, and visualized using a quantile-quantile plot. The variables were not normally distributed and were further compared between the two groups using the Mann-Whitney U test.
Nominal variables (mucosal injuries, bleeding, and dental damage) were compared between the groups using the chi-square test, although this was only possible for mucosal injuries, as bleeding and dental damage were not recorded.
A statistical significance level and a probability of error were defined for all test procedures performed as a p-value of <0.05. Consequently, the null hypothesis is considered to be retained for a p-value greater than 0.05, and rejected for a p-value less than 0.05.

5.3 Patients

A total of 100 patients were recruited as planned. In one case, only the first page of the questionnaire was completed so that most of the data for one patient was missing. The collective consisted of 47% women and 53% men. The age ranged from 23 to 84 with a mean of 59.04 years and a standard deviation of 13.165.
A total of 67 outpatient and 33 inpatient procedures were recorded. The allocation to type of procedure (inpatient - outpatient) was based on diagnosis, presence of comorbidities and other anesthesiologic reasons. The inpatient group was therefore more frequently made up of older or sicker patients than the outpatients. 7 of the patients originally planned to receive outpatient treatment were ultimately admitted as inpatients.
The shortest operation duration was 3 minutes and the longest 70 minutes. The mean duration of surgery was 20 minutes with a standard deviation of 10.559.
The following diagnoses were the indication for microlaryngoscopic surgery:

Polyp, vallecle cyst / base of tongue cyst, leukoplakia, laryngeal papillomatosis, Reinke's edema, paresis (of vocal folds / recurrent laryngeal nerve / larynx), spasmodic dysphonia / voice tremor, laryngeal cyst, chronic laryngitis, epiglottis cyst, space-occupying lesion, glottic stenosis, pocket fold cyst, subglottic neoplasm, carcinoma in situ, contact granuloma, sulcus, hyperkeratosis and dysphonia / atrophy.

Sex	Frequency	Percent
female	47	47,0
male	53	53,0
Total	100	100,0

Table 2: Sex

Type	Frequency	Percent
Outpatient	67	67,0%
Inpatient	33	33,0%
Total	100	100,0%

Table 3: Type of operation

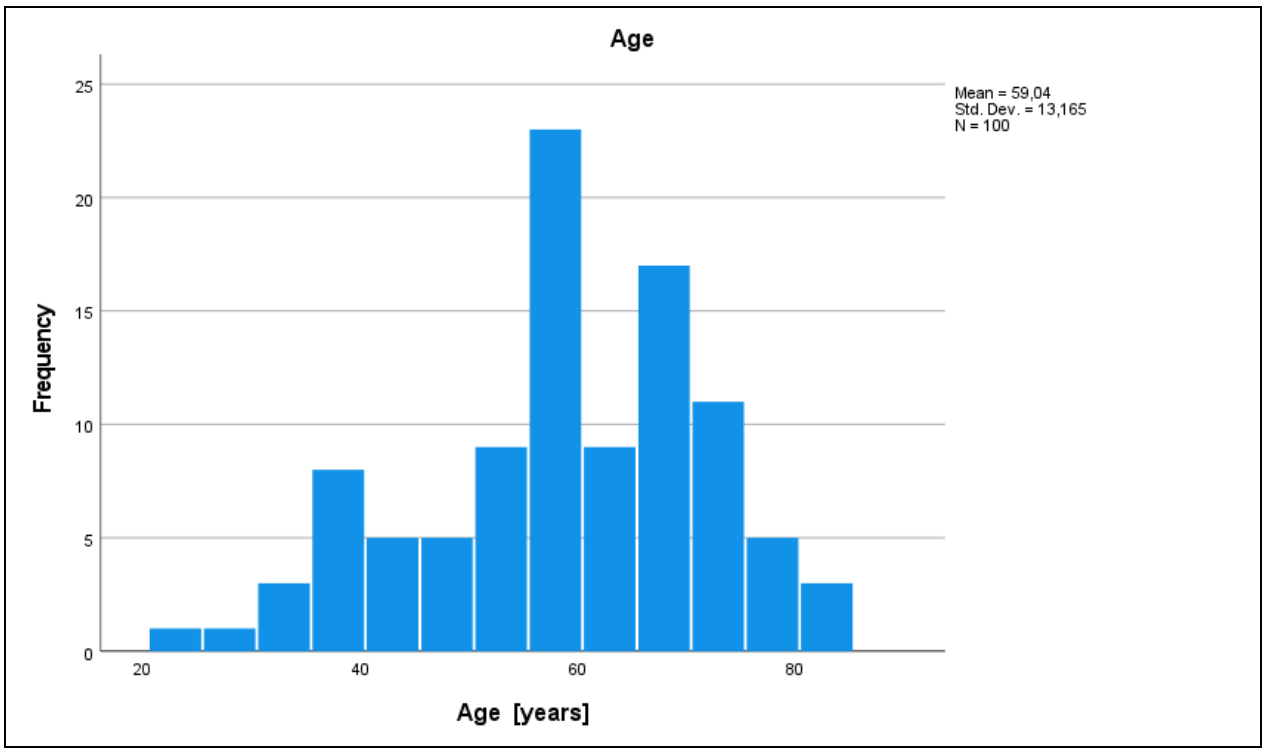

Figure 2: Age distribution

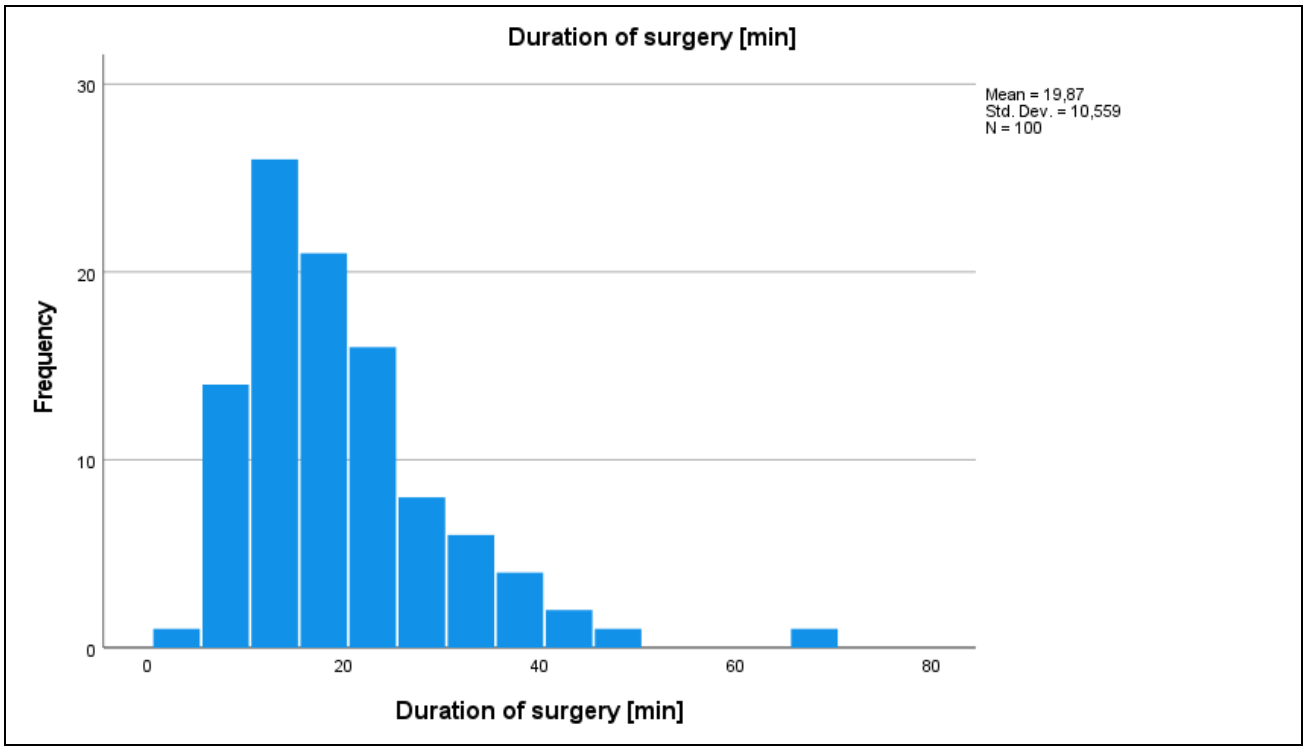

Figure 3: Duration of surgery

		N	Percent
Diagnosis	Polyp	18	17,1%
	Space-occupying lesion	2	1,9%
	Vallecle cyst, base of tongue cyst	16	15,2%
	Epiglottis cyst	2	1,9%
	Pocket fold cyst	1	1,0%
	Laryngeal papillomatosis	11	10,5%
	Spasmodic dysphonia, voice tremor	5	4,8%
	Reinke's edema	9	8,6%
	Leukoplakia	16	15,2%
	Chronic laryngitis	4	3,8%
	Paresis (vocal folds / recurrent laryngeal nerve / larynx)	8	7,6%
	Laryngeal cyst	5	4,8%
	Subglottic neoplasm	1	1,0%
	Carcinoma in situ	1	1,0%
	Contact granuloma	1	1,0%
	Sulcus	1	1,0%
	Glottic stenosis	2	1,9%
	Hyperkeratosis	1	1,0%
	Dysphonia, atrophy	1	1,0%
Total		105	100,0%

Table 4: Frequencies of diagnosis

6 Results - results with graphs

6.1 Objective parameters gathered by physicians

Postoperative mucosal lesions of the larynx and/or pharynx were observed in 2% (n=2) of the patients. Even if both mucosal injuries were described in the outpatient group, no statistically significant difference was found due to the low incidence.

No bleeding and/or postoperative rebleeding, tooth damage, or tooth loss occurred during the study.

The mean duration between discharge and the postoperative follow-up appointment was 14 days, with a standard deviation of 5.333. Twelve of the 100 patients did not require a postoperative follow-up.

There was no difference between the inpatient and outpatient groups in terms of the duration of surgery or the duration between the date of discharge and postoperative follow-up appointment.

Further complications (recorded at the postoperative follow-up appointments) occurred in three of the 88 patients for whom a follow-up appointment was scheduled. This corresponds to a percentage of 3.4 %. The reported complications were throat difficulties (bilateral thickening in the back of the throat when clearing the throat), a possible residual of the polyp, and a postoperative wound healing disorder (at the third follow-up appointment 12 days later, the patient had no further symptoms).

There was no correlation between sex and risk of complications.

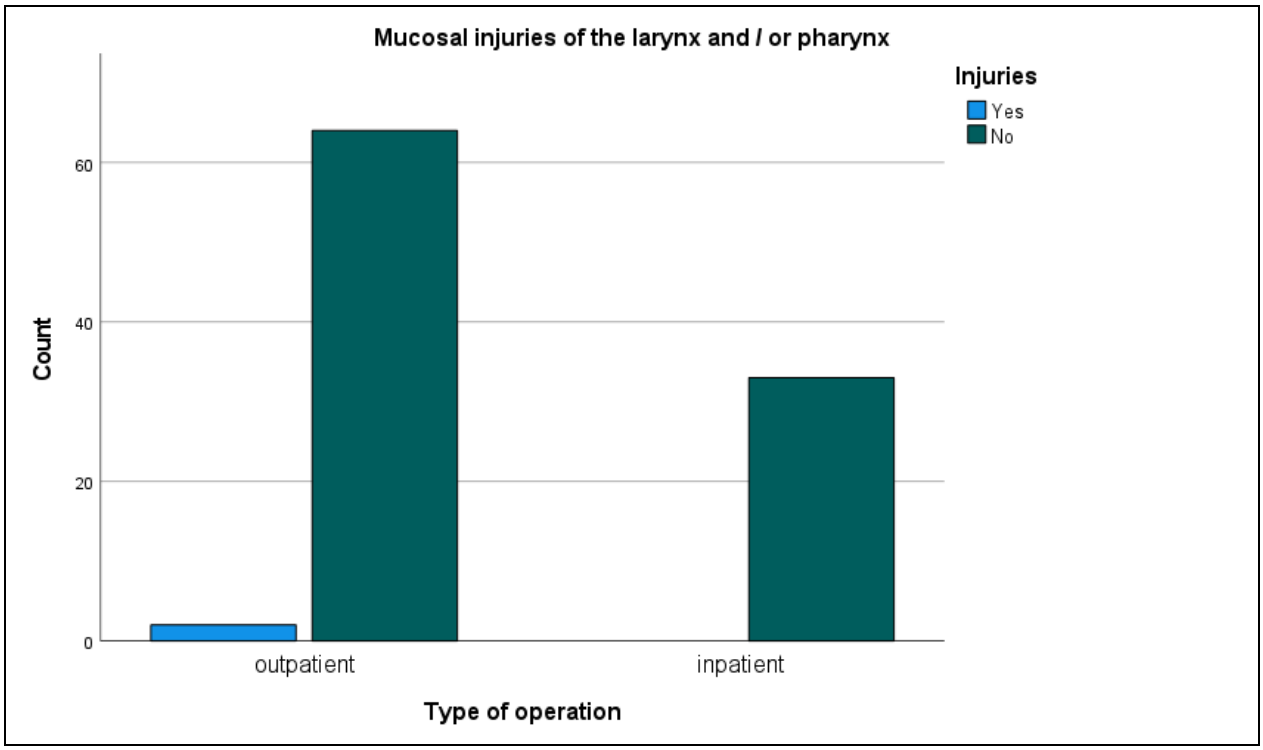

Figure 4: Mucosal injuries of the larynx / or pharynx

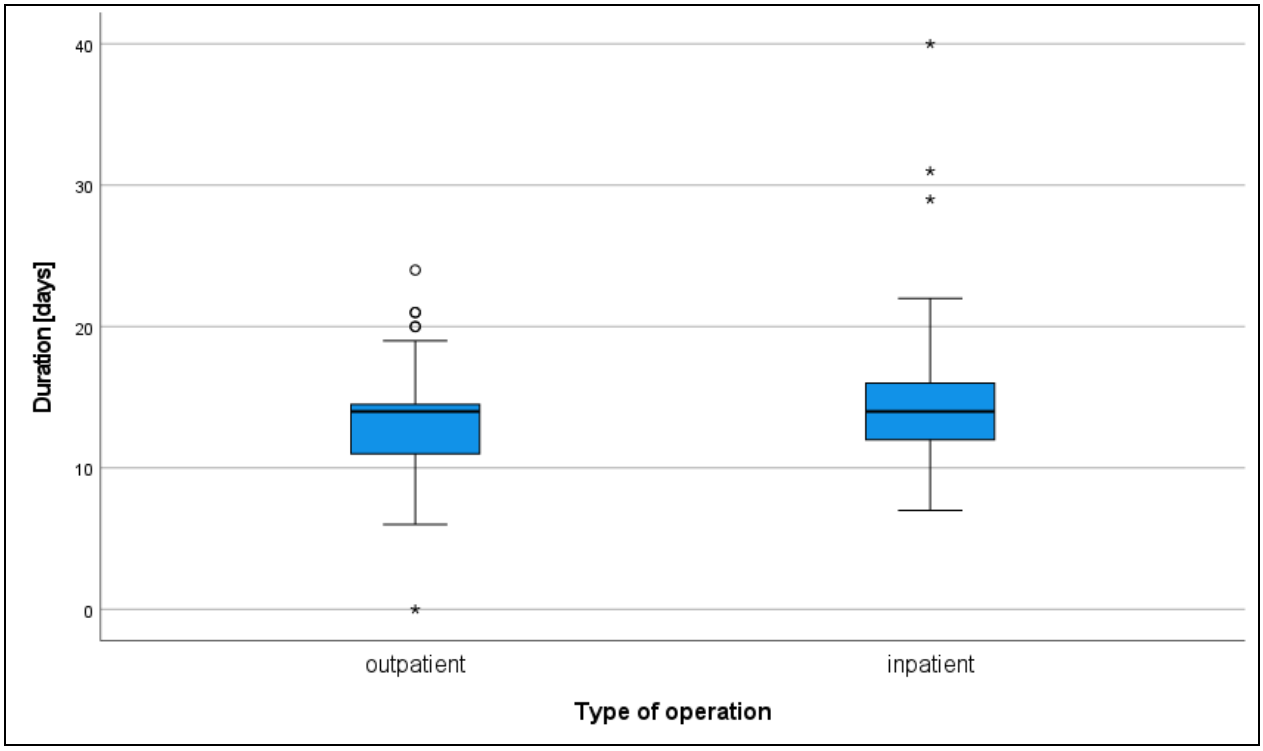

Figure 5: Duration in between visits

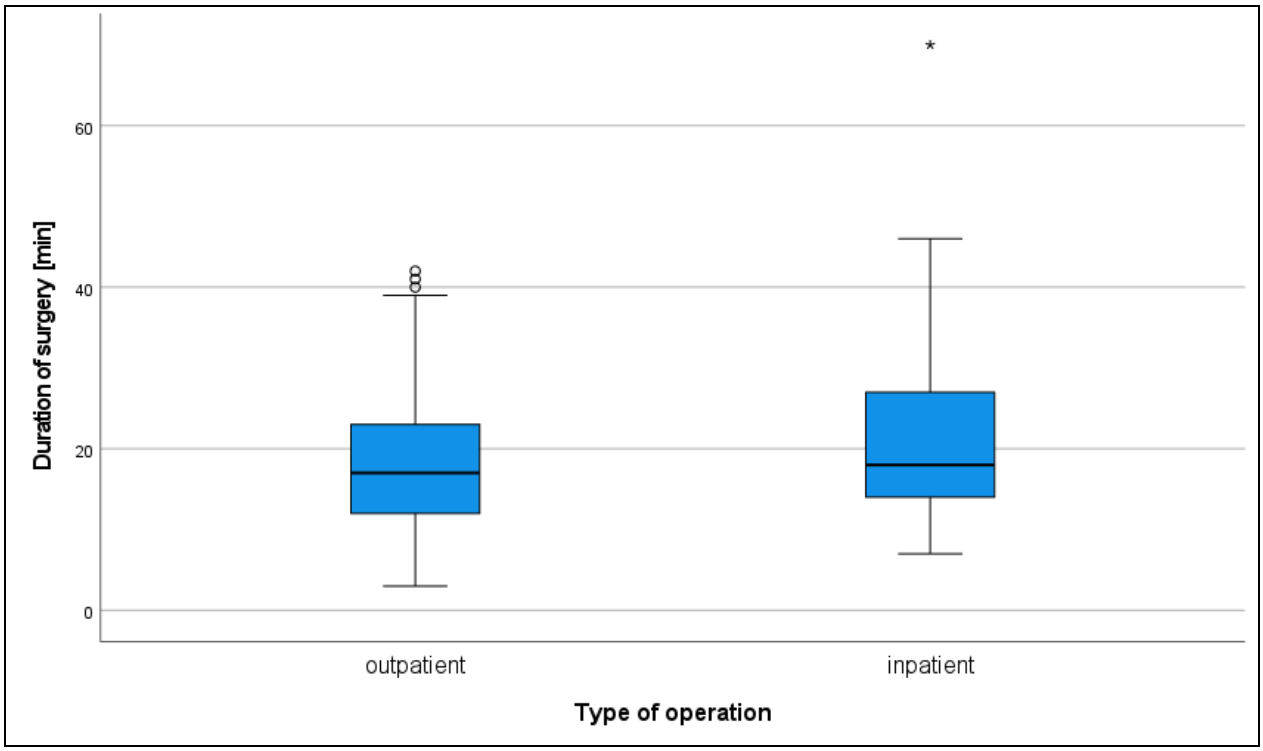

Figure 6: Duration of surgery

6.2 Subjective data provided by patients

Subjective data collected from all patients (both in the inpatient and outpatient groups) were recorded on a scale from 0 to 8. where 0 stands for "none" and 8 for "very severe." The following tables provide an overview of the severity of the symptoms reported by patients across all categories. No statistically significant correlation was found between the duration of surgery and any of the subjective variables surveyed.

		N	Percent
Subjective complaints (both dates)	None	1127	86,3%
	1	67	5,1%
	2	49	3,7%
	3	23	1,8%
	4	17	1,3%
	5	11	0,8%
	6	3	0,2%
	7	6	0,5%
	Very severe	4	0,3%
Total		1307	100,0%

Table 5: Subjective complaints on both dates

		N	Percent
Subjective complaints (discharge)	None	601	86,7%
	1	38	5,5%
	2	22	3,2%
	3	12	1,7%
	4	10	1,4%
	5	3	0,4%
	7	4	0,6%
	Very severe	3	0,4%
Total		693	100,0%

Table 6: Subjective complaints at time of discharge

		N	Percent
Subjective complaints (follow-up)	None	526	85,8%
	1	29	4,7%
	2	27	4,2%
	3	11	1,8%
	4	7	1,1%
	5	8	1,3%
	6	3	0,5%
	7	2	0,3%
	Very severe	1	0,2%
Total		614	100,0%

Table 7: Subjective complaints at time of follow up

6.2.1 Pain

At the time of discharge, 74.6% (n=74) of the 99 patients reported no pain. Pain was rated as 1 in 10.1% (n=10), 2 in 8.1% (n=8), 3 in 5.1% (n=5), and 7 in 2.1% (n=2) of the patients.

By the time of the postoperative follow-up, 80.7% (n=71) of the 88 patients were pain-free. The patients who reported pain rated it as 1 in 6.8% (n=6), 2 in 5.7% (n=5), 3 in 2.3% (n=2), 4 in 2.3% (n=2), 5 in 1.1% (n=1), and 6 in 1.1% (n=1).

On comparing the inpatient and outpatient groups, no statistically significant difference was found either at the time of discharge or at the time of postoperative follow-up.

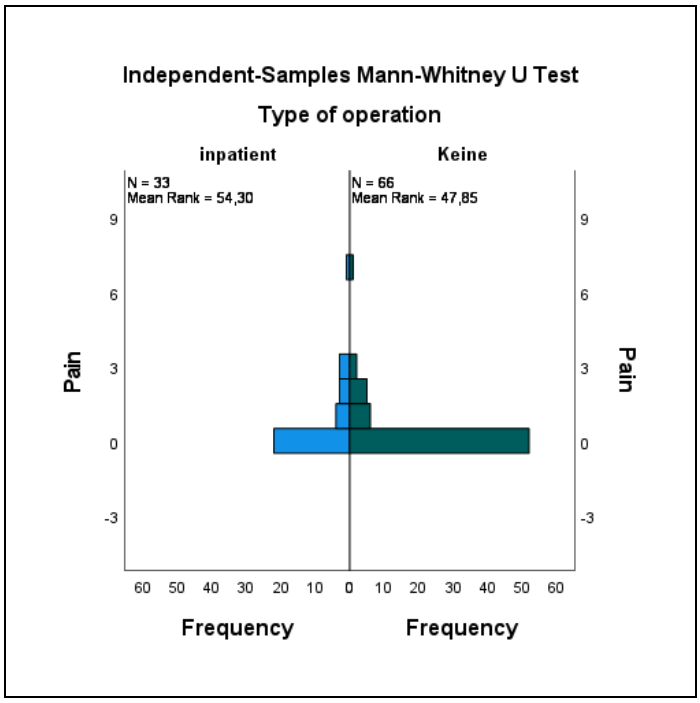

Figure 7: Pain at the time of discharge

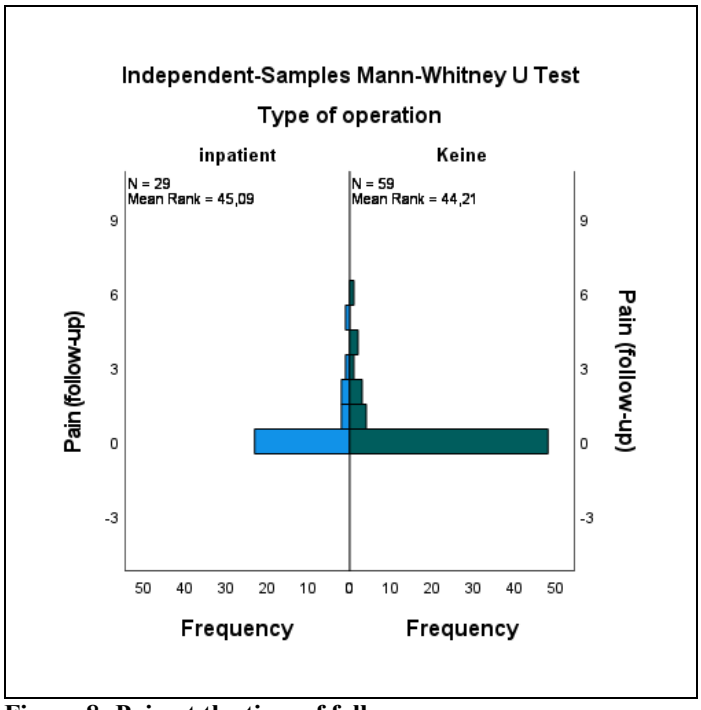

Figure 8: Pain at the time of follow up

6.2.2 Swallowing difficulties

A total of 77.8% (n=77) of the 99 patients at the time of discharge stated that they had no swallowing difficulties. Patients who complained of swallowing difficulties rated these as 1 in 16.2% (n=16), 2 in 5.1% (n=5) and 4 in 1.0% (n=1).

During the post-operative follow-up 76.1% (n=67) of the 88 patients stated that they experienced no swallowing difficulties. Those patients who complained of swallowing difficulties rated these as 1 in 8% (n=7), 2 in 9.1% (n=8), 3 in 3.4% (n=3), 4 in 1.1% (n=1), 5 in 1.1% (n=1) and 6 in 1.1% (n=1) of cases.

Comparing the inpatient and outpatient groups, no statistically significant difference was found either at the time of discharge or at the time of postoperative follow-up.

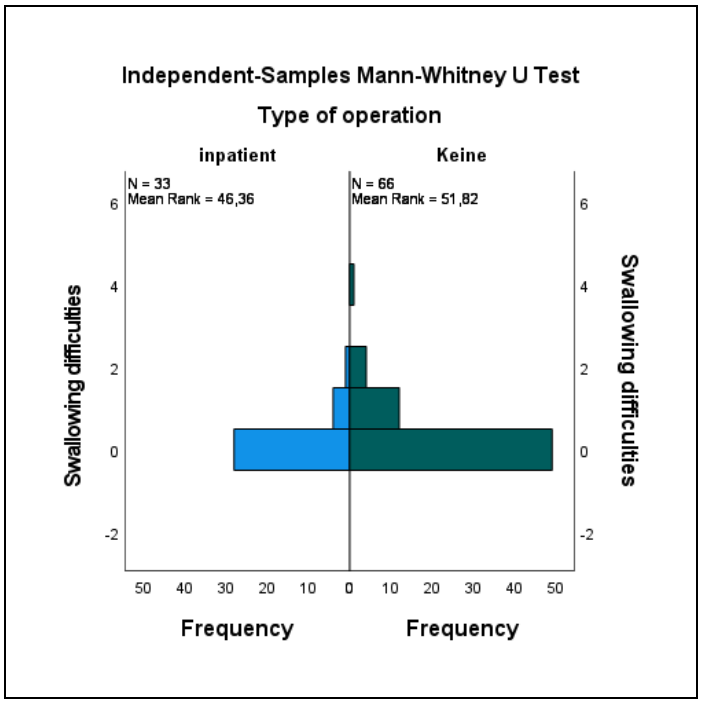

Figure 9: Swallowing difficulties at the time of discharge

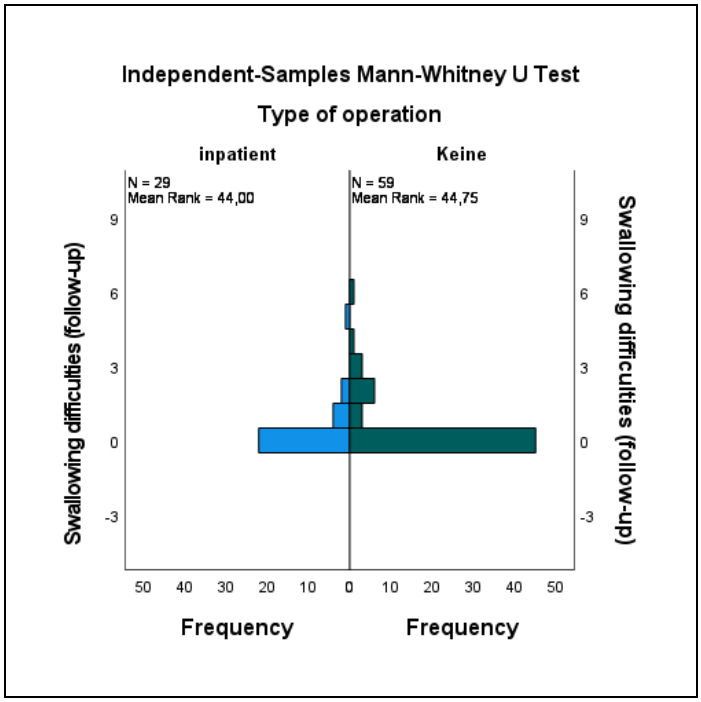

Figure 10: Swallowing difficulties at the time of follow up

6.2.3 Sensory, movement or taste disorders in the tongue area

At the time of discharge, 93.9% (n=93) of the 99 patients stated that they had no sensory, movement or taste disorders in the tongue area. Out of patients who reported sensory, movement or taste disorders in the tongue area, 4% (n=4) reported 1, 1% (n=1) reported 4 and 1.0% (n=1) reported 5.

At the time of the postoperative follow-up, 94.3% (n=83) of the 88 patients reported no sensory, movement or taste disorders in the tongue area. The patients who complained of sensory, movement or taste disorders in the tongue area described these as 1 in 3.4% (n=3), 2 in 1% (n=1) and 7 in 1% (n=1) of cases.

Comparing the inpatient and outpatient groups, no statistically significant difference was found either at the time of discharge or at the time of postoperative follow-up.

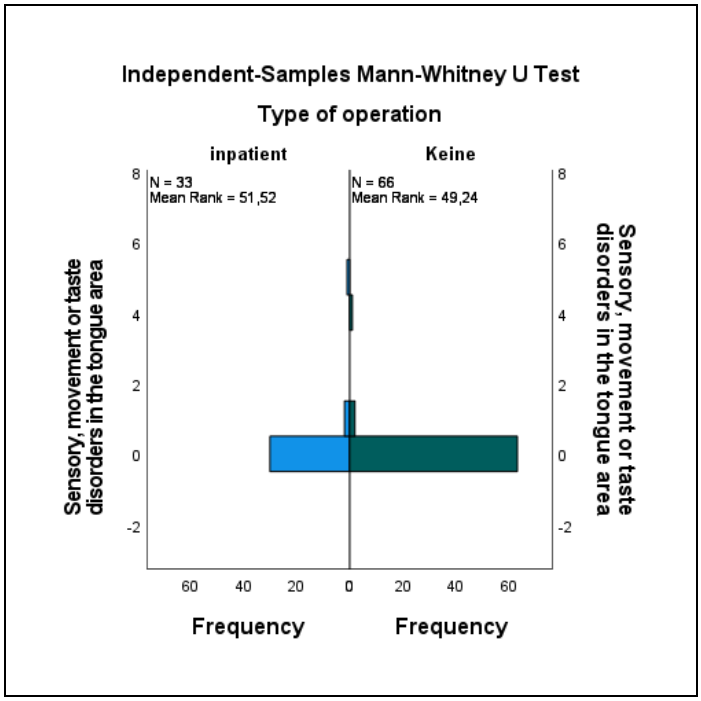

Figure 11: Sensory, movement or taste disorders in the tongue area at the time of discharge

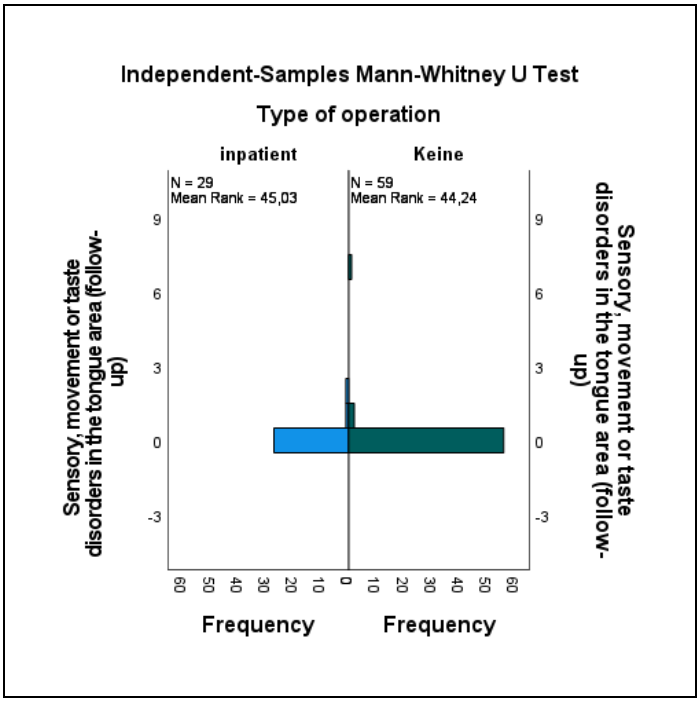

Figure 12: Figure 13: Sensory, movement or taste disorders in the tongue area at the time of follow up

6.2.4 Temporomandibular joint problems

At the time of discharge, none of the 99 patients reported having temporomandibular joint problems.

On postoperative follow-up, 98.9% (n=87) of the 88 patients reported no temporomandibular joint problems. The patient (1.1%) with temporomandibular joint problems rated it as 1.

Comparing the inpatient and outpatient groups, no statistically significant difference was found either at the time of discharge or at the time of postoperative follow-up.

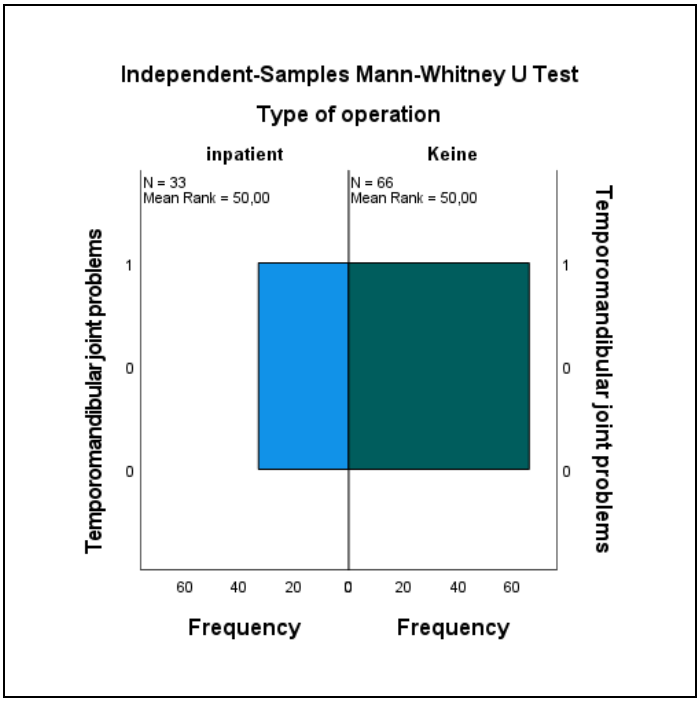

Figure 14: Temporomandibular joint problems at the time of discharge

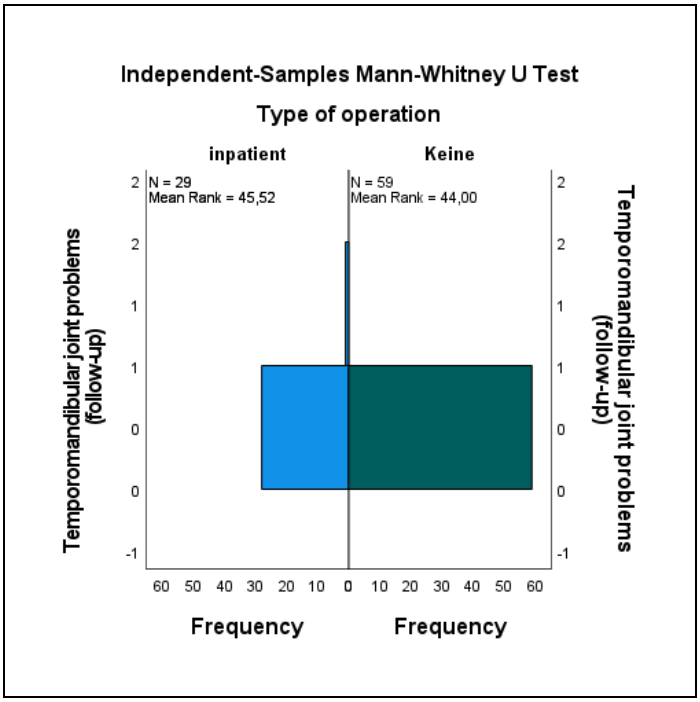

Figure 15: Temporomandibular joint problems at the time of follow up

6.2.5 Hoarseness

Out of 99 patients, 64.6% (n=64) reported no hoarseness at the time of discharge. Those who complained of hoarseness rated it as 1 in 8.1% (n=8), 2 in 7.1% (n=7), 3 in 6.1% (n=6), 4 in 8.1% (n=8), 5 in 2.0% (n=2) and 7 in 1.0% (n=1).

At the time of the postoperative follow-up, 59.1% (n=52) of the 88 patients stated that they had no hoarseness. Of the patients who complained of hoarseness, 11.4% (n=10) reported

it as 1, 12.5% (n=11) as 2, 3.4% (n=3) as 3, 3.4% (n=3) as 4, 6.8% (n=6) as 5, 1.1% (n=1) as 6, 1.1% (n=1) as 7 and 1.1% (n=1) as 8.

Comparing the inpatient and outpatient groups, no statistically significant difference was found either at the time of discharge or at the time of postoperative follow-up.

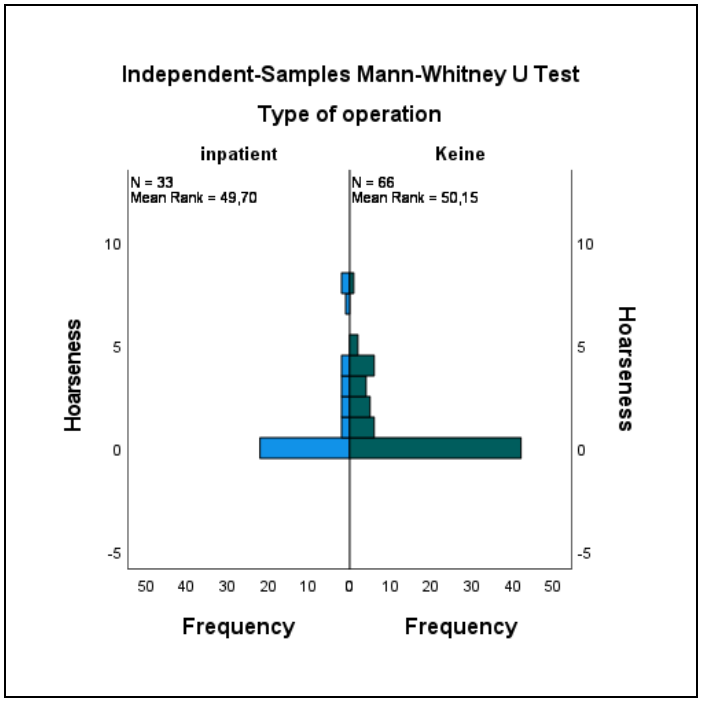

Figure 16: Hoarseness at time of discharge

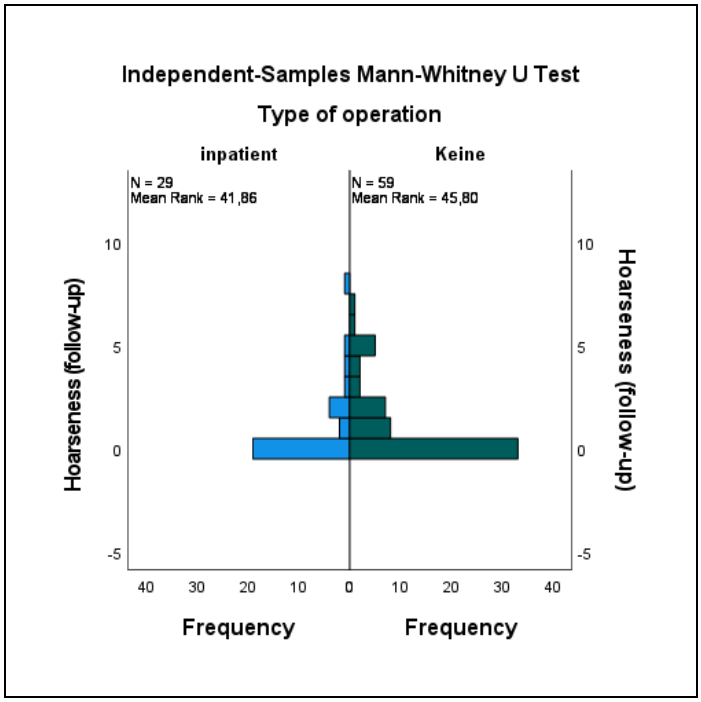

Figure 17: Hoarseness at time of follow up

6.2.6 Shortness of breath

At the time of discharge, 98% (n=97) of the 99 patients stated that they had no shortness of breath. Of the patients who complained of shortness of breath, 1.1% (n=1) reported it as 2 and 1.1% (n=1) as 7.

At the time of the post-operative follow-up, 97.7% (n=84) of the 88 patients stated that they had no shortness of breath. Of the patients who complained of shortness of breath, 1.2% (n=1) reported it as 3 and 1.1% (n=1) as 4.

In the comparison between the inpatient and outpatient groups, a statistically significant difference was found at the time of discharge, but no statistically significant difference was found at the time of follow-up.

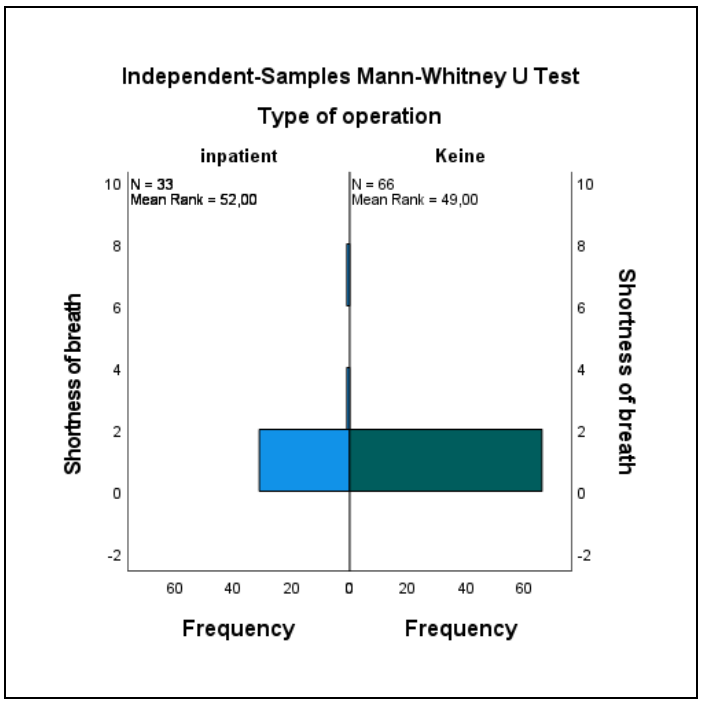

Figure 18: Shortness of breath at time of discharge

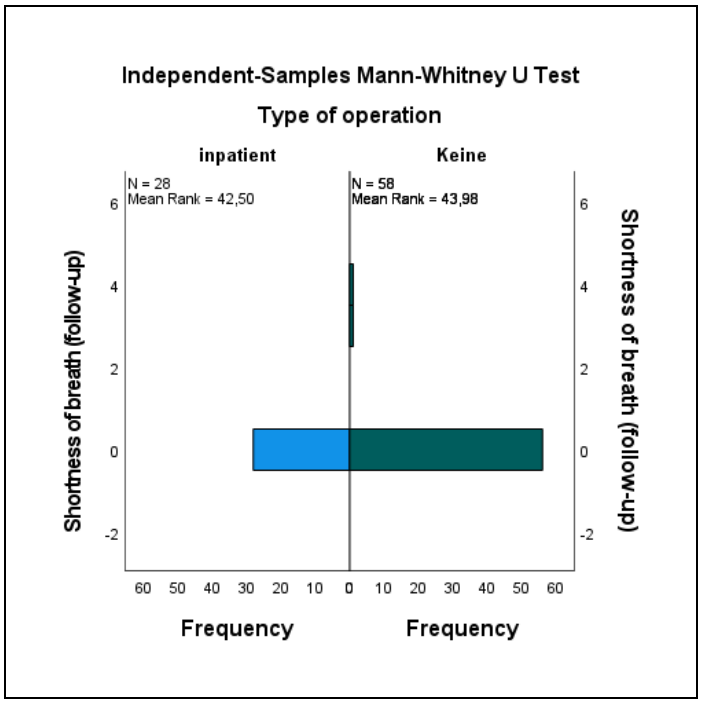

Figure 19: Shortness of breath at time of follow up

6.2.7 Other accompanying symptoms

At the time of discharge 2 out of the 99 Patients complained about other accompanying symptoms these were as follows: one Patient complained of an urge to clear his throat and rated this as a 3, the other patient described a feeling of dizziness and nausea and rated this as a 2.

At the time of the post-operative follow-up 5 out of the 88 patients reported other symptoms: Three of them reported being congested with phlegm (one rated it at 1, one rated it at 2 and one rated it at 3), one patient reported a rash on the neck about 2 days after the procedure (rated at 3), one patient reported a slight itchy throat (rated at 1).

6.3 Findings regarding diagnosis

No statistically significant correlation was found between the duration of surgery and the underlying diagnoses.

No statistically significant correlation was found between the diagnosis and the variables: pain; pain at the follow-up appointment; difficulty swallowing; difficulty swallowing at the follow-up appointment; sensory-, movement- or taste disorders in the tongue area; sensory-, movement- or taste disorders in the tongue area at the follow-up appointment; temporomandibular joint problems; temporomandibular joint problems at the follow-up appointment; hoarseness; shortness of breath. However, a statistically significant correlation concerning the underlying diagnoses could only be found for hoarseness at the

time of follow-up (asymptotic significance of 0,006) and shortness of breath at the time of follow-up (asymptotic significance of <0,001).

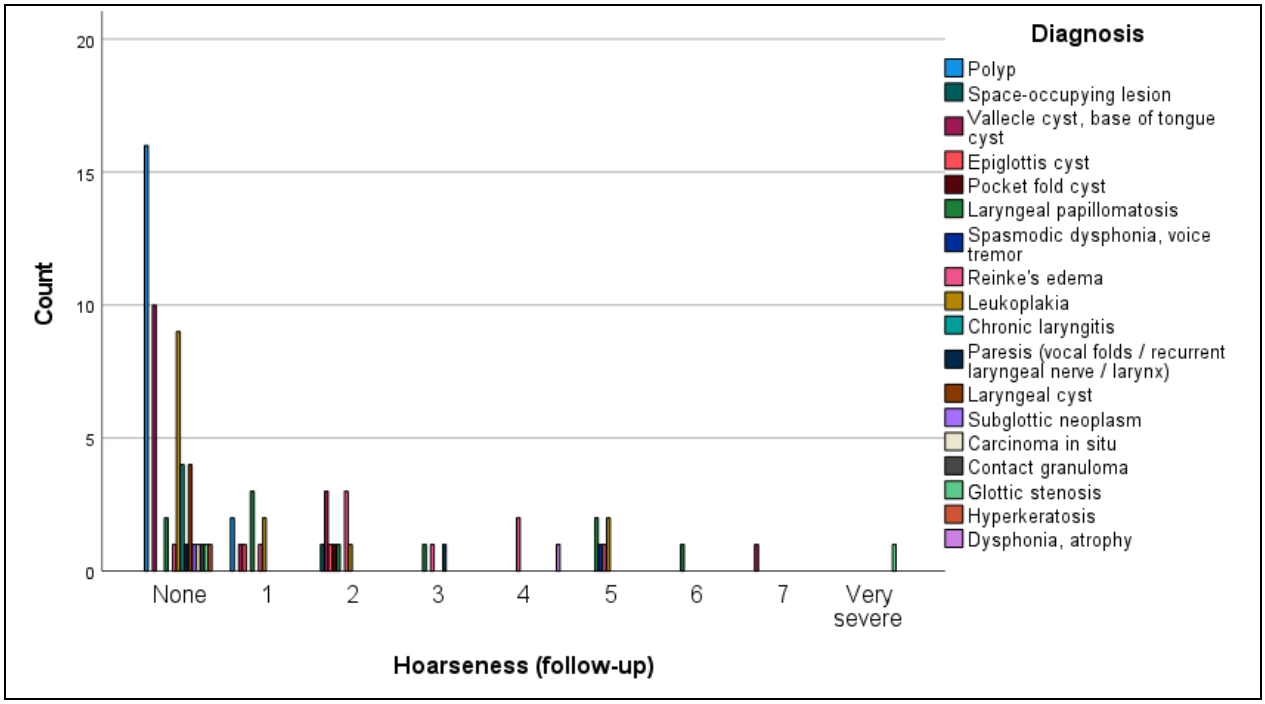

Figure 20: Distribution of diagnoses relating to hoarseness at the time of follow-up

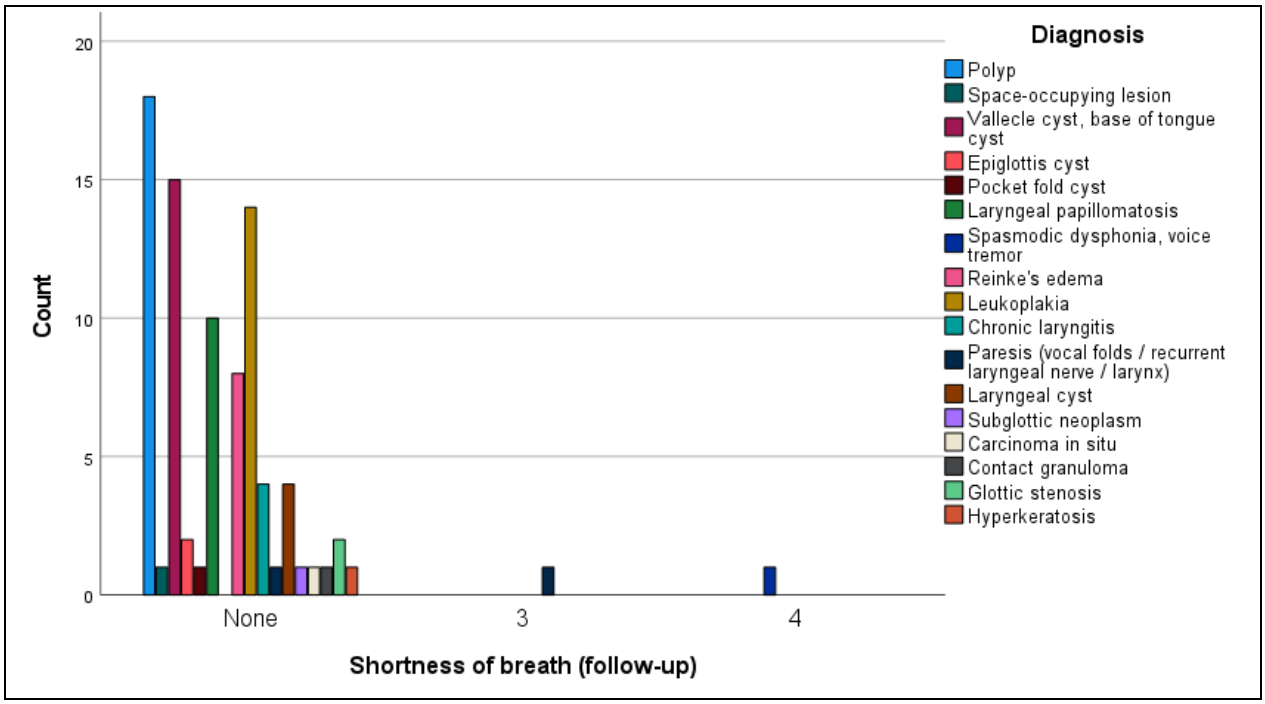

Figure 21: Distribution of diagnoses relating to shortness of breath at the time of follow-up

6.4 Rates of complaints and complications

Overall, the doctors reported a complication rate of 5.4%, which consisted of 2% mucosal injuries and 3.4% further postoperative complications. The two different complications did not overlap in any of the patients.

At the time of discharge, 34 patients had no subjective complaints, and at the time of follow-up, 42% had no subjective complaints. Overall, 19% of the patients stated that they had never experienced any subjective complaints during treatment.

6.5 Satisfaction in the outpatient group

As part of the study, the satisfaction of patients in the outpatient group with the procedure was recorded on a scale from 1 (= not satisfied) to 5 (= very satisfied). As with the other data provided by the patients, the survey was carried out on the day of discharge and again at the follow-up appointment for patients with a planned postoperative check-up.

At the first time point, 97% (n=64) of the 66 patients reported a satisfaction rating of 5. 1.5% (n=1) rated their satisfaction as 4 and 1.5% (n=1) as 1.

At the second time point, 94.9% (n=56) of the 59 patients gave a satisfaction rating of 5. 3.4% (n=2) gave a satisfaction rating of 4 and 1.7% (n=1) gave a satisfaction rating of 3.

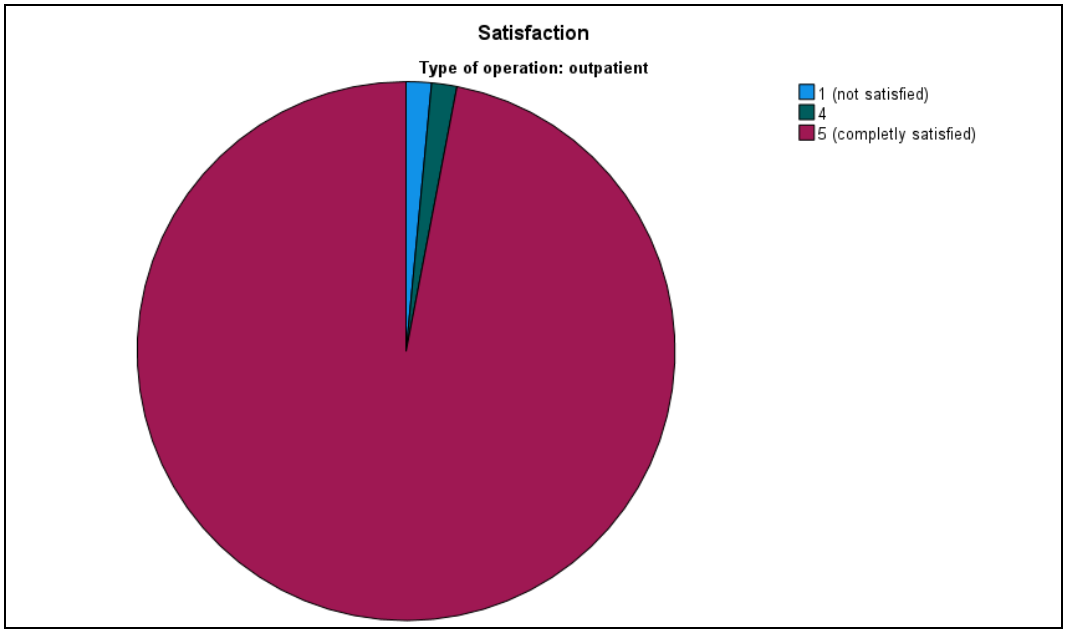

Figure 22: Outpatient satisfaction at time of discharge

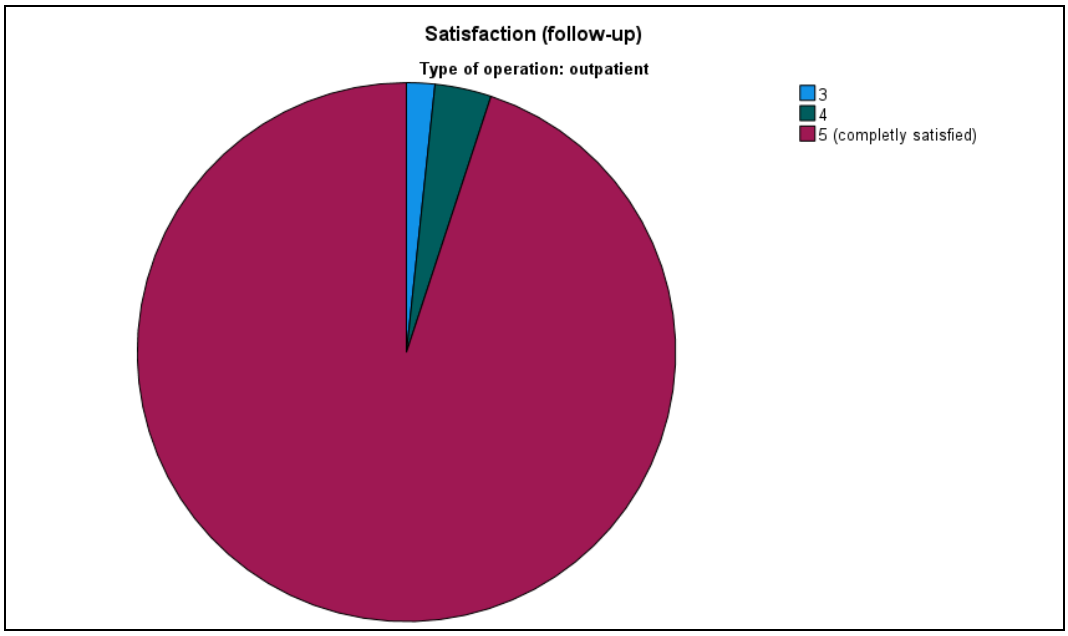

Figure 23: Outpatient satisfaction at time of follow up

7 Discussion

7.1 Summary of the study

As part of this study on complications in general and patient satisfaction in outpatient microlaryngoscopic procedures, a complication rate of 5.4%, an absence of subjective complaints on both examination dates of 86.3% and a high level of patient satisfaction both at the time of discharge and at the time of follow-up (97% and 94.5%) were found in the 100-patient collective containing 67 outpatient treatments with 19 different underlying diagnoses.

7.2 Relevance of the Results

The relevance of this study is primarily due to the large potential shift towards day-clinic interventions in the Austrian healthcare system. The determination of complication rates and the survey of patient satisfaction with day-clinic interventions shows that the advantages of day-clinic interventions can also be realized in the Austrian healthcare system.

Furthermore, the survey of complication rates, particularly in comparison with the international literature, provides a realistic analysis of the quality standard of this facility.

7.3 Limits and strengths of this study

The low rate of complications and complaints makes statistical calculations and conclusions that can be drawn difficult, as s large part of the data basically acts as constants in terms of statistical analysis. The grouping of patients into outpatients and inpatients based on their risk profile also resulted in an overall higher-risk inpatient collective. A further limitation of this study is that the preoperative hoarseness was not recorded to allow a comparison between the pre- and postoperative hoarseness. Furthermore, the satisfaction of inpatients was not recorded. The final limitation is that satisfaction was based on the satisfaction communicated to the doctor and may therefore have been presented more positively by the patients in order to satisfy the doctor.

The strengths of this study lie in the prospective data collection, the fact that the questionnaires were completed by doctors, which prevents possible comprehension problems, the inclusion of all patients regardless of gender, age or pre-existing risk factors for complications such as poor dental status, as well as the collection of both subjective and objective data in accordance with the biopsychosocial model. Furthermore, there is

also good reproducibility, as doctors with different levels of knowledge and experience acted as surgeons.

7.4 Comparison to other studies

A uniform comparison of this study with other studies conducted on microlaryngoscopic procedures is possible to a limited extent. This is due to the fact that "complications" were defined differently across all studies and therefore the rate of recorded complications varies considerably.

In the international literature, complication rates of 0–79% have been described, some of which were further subdivided into mild, moderate, and severe complications. The maximum rate of severe complications of 19.5% was described by Hendrix et al.(5) Their study has been discussed in the subsequent scientific literature. In the process, the stated rate was criticized as being "unrealistically high."(4) Other studies that specifically described severe complications reported rates of 0% (4, 9, 12), 0.42% (3), and a maximum of 0.5% (11). We were also unable to identify any complications that could be classified as severe.

The majority of complications recorded were classified as mild by the respective authors and range from approximately 20% (5, 11) to 68% (4). Comparing this ratio as well as the overall complication rate, this study's complication rate is among the lowest reported internationally.

This could be due to the high level of practical skills of the surgeons. Consistent minimization of the risk of complications could also have contributed to this low rate. For example, the force required for the correct visualization of anatomical features can be significantly reduced by the correct positioning of the head (9, 20). The hypothesis that the complication rate is due to practical skills and risk minimization is further underlined by the fact that none of the procedures performed in this study resulted in tooth damage or loss. The rates of tooth damage in the international literature are 0% (9, 12), 0.9% (2), 1% (8), 2.5% (4), and 6.5% (23), which are indicative of the high degree of force applied during an operation (4). The relatively short operation time of approximately 20 minutes in this study may also have contributed to the low complication rate, as a long operation time, as described by Gräfe (8), Tessema (21), and Rosen (12), represents a risk factor for complications.

A correlation between sex and an increased risk of complications, as described by Tessema et al. (21), could not be established in this study.

In this study, complaints and complications were broken down in great detail into objective conditions described by doctors and subjective complaints of patients, which has not been done in any other study on this topic.

7.5 Advantages and disadvantages of outpatient treatment

7.5.1 General advantages and disadvantages of outpatient treatment

The modern healthcare landscape is constantly evolving, with an increasing emphasis on enhancing patient care, while also seeking efficiency in how services are delivered. The shift from inpatient to outpatient treatment modalities has been a significant trend in healthcare, with the aim of reducing costs, enhancing patient convenience, and maintaining high standards of quality and safety. The 2020 report by the Institute for advanced studies Vienna observed the movement of certain healthcare services from inpatient care to outpatient treatments globally, including Austria, as detailed in a comprehensive study. Their study meticulously explored the potential and implications of transitioning specific operative services to outpatient settings using a multitude of procedures such as carpal tunnel surgery, appendectomy, or tonsillectomy as a focal point. (6)

Based on the scoping review, it is evident that outpatient surgery is a common practice in many countries, particularly in the healthcare systems of Northern and Western Europe, Canada, and the United States. In contrast, outpatient surgery is almost an exception to this rule in the Austrian health care system. The report suggests that some services, when shifted to outpatient settings, can maintain the same level of quality and safety.

In general, the Institute for advanced studies describes cost-effectiveness, convenience, and efficiency as the main advantages of outpatient treatments. The limited scope, infrastructural and training needs, and regulatory and reimbursement challenges were described as disadvantages. (6)

Although the report does not specify costs owing to the lack of studies on this topic, it is widely recognized that outpatient care tends to be less expensive than inpatient care. This is due to the elimination of costs associated with overnight hospital stays, such as necessary night, holiday, and weekend shifts, and the reduced use of hospital resources such as material consumption. (6)

Additionally, outpatient treatment also comes with the benefit of increasing surgical capacity by eliminating the need to occupy beds. Thus, there is no need to wait until a bed occupied by a patient becomes free again in order to operate on a new patient who subsequently requires this bed.

The report further elaborates that outpatient services are designed for the convenience of patients, allowing them to return home on the same day. This seems to allow for greater patient satisfaction due to reduced disruption to their own lives and faster return to the workplace. (6)

For treatments classified as “Level 2,” such as Carpal Tunnel Operations, which can be performed in specialized outpatient settings or even in modified doctor’s offices, this can significantly reduce disruption to patients’ lives. However, not all treatments can or should be administered on an outpatient basis. The classifications applied in the report, such as “Level 2” for certain procedures, indicate that only those procedures with a certain safety profile and complexity are suitable for outpatient treatment. (6)

7.5.2 Outpatient treatment for microlaryngoscopic surgery

In the international literature, microlaryngoscopic procedures are generally considered safe and have few complications. Only the 1994 study by Hendrix et al.(5) found that 19.5% of patients had serious complications that required hospitalization and, based on this, recommended that patients be observed in the hospital for at least 24 h after such procedures. Risk factors that could reliably predict which patients were at an increased risk of serious complications could not be identified by the researchers. It should however be noted that they included only patients with hand and neck malignancies in their study. However, these figures and their recommendations could be confirmed in subsequent studies.

Lee et al. (29) were able to show in 1998, that 100% (n=8) of their patients who went on to have major complications and 92.3% (n=24/26) who went on to have any complication were successfully identified prior to discharge. They also identified five statistically significant risk factors for the occurrence of further complications: pre-existing heart disease, American Society of Anesthesiologists classification, airway classification, type of anesthesia and the number of endoscopic procedures performed.

They concluded that selective hospital admission based on clinical judgment was superior to routine admission of all patients and recommended that upper tract endoscopy be performed on an ambulatory basis. In their opinion, the main reasons for their recommendations were the low complication rate, the fact that complications requiring inpatient management were identifiable in the immediate postoperative period, and the fact that this approach seemed to be the most economical.

In 2005, Armstrong et al. (30) reexamined the safety of direct laryngoscopy as an outpatient procedure. They reviewed 689 direct laryngoscopies performed at a new ambulatory surgery center. There were nine unplanned hospitalizations, including five airway emergencies within 30 minutes of extubating. The study found that the risk of airway emergencies after direct laryngoscopy was less than 1% in carefully selected patients. It should be noted that the microlaryngoscopic surgery can be performed safely as long as rapid transfer to the hospital is ensured. When deciding whether direct laryngoscopy should be performed on an outpatient basis, Armstrong et al. stated that this is influenced by the available equipment and personnel, likelihood of discharge (probability of patient discharge at 18.00 o´clock greater than 50%), and no indication for outpatient observation after surgery. As requirements for discharge, the authors stated an awake patient, stable vital signs, oxygen saturation on room air above 95% or at baseline, ability to transport the patient, and adequate care at home. The ability to drink and urinate spontaneously can often be ruled out by an anesthesiologist on a case-by-case basis. Preoperative assessment plays a central role in assessing the risk of complications after microlaryngoscopic surgery. According to Armstrong et al., the assessment of the responsible surgeon appears to be the best predictor of hospitalization. Patients are scheduled for inpatient surgery if they are unable to care for themselves at home or if they are expected to have an unstable airway after the procedure (bilateral vocal fold motion restriction, severe stenosis requiring stent placement, or large or friable tumors in the airway).

Mahboubi et al. (31) were also able to confirm the safety of these procedures in 2013 based on relatively low complication rates. The rate of unexpected hospitalization after surgery was less than 4%. The authors compared their results with those of previous reports and concluded that the rate of unexpected hospital admissions after laryngoscopy and related procedures is comparable to or even better than previously reported rates, which ranged from 0 to 3%. This further strengthens confidence in the safety of microlaryngoscopic surgery in the day hospital setting.

In 2015, Orosco et al. (3) concluded that outpatient laryngoscopy has a favorable safety record. Nevertheless, they emphasize that preoperative risk stratification for the identification of patients suitable for such a procedure, as well as patient counseling and emergency preparedness, are essential to assess the suitability of outpatient microlaryngoscopic procedures.

Orosco et al. confirmed the trend of outpatient laryngology surgery. According to them, this trend requires adapted surgical strategies to ensure the safety of these procedures, while taking advantage of the benefits of outpatient procedures, such as lower costs and shorter recovery times.

Based on the extremely low complication rates, absence of serious complications, and very high level of patient satisfaction, this study confirms the safety and above-mentioned advantages also in the Austrian healthcare system. In line with the recommendations of international literature, an individual selection between inpatient and outpatient treatment was also made by the respective doctor based on the patient's individual risk profile in this study.

The decision as to whether a patient is operated on as an inpatient or outpatient case should be made jointly by the surgeon and the anesthesiologist, as the complication rate of microlaryngoscopic procedures as described by Marinov (22), for example, depends significantly on the experience of both the anesthesiologist and the surgeon. This was also recommended by Orosco et al (3) who found that selective decisions regarding admission to the ward based on the clinical presentation of the individual patient were superior to routine hospital admission.

Parameters that may be helpful for evaluation include the degree of neck flexion required to expose the vocal folds, ASA status, Malampati Classification Score and laryngoscope grade. (12)

Furthermore, the place of residence and thus the proximity to the nearest hospital should also be taken into consideration in case complications occur.

7.6 Summary

Recent studies, including this one, suggest that many microlaryngoscopic procedures can be successfully transitioned to an outpatient basis, especially when supported by improved surgical techniques and rigorous patient selection criteria.

Concerns regarding the quality and safety of outpatient procedures have recently been addressed. Beyond these concerns, this study also showed that there is a high level of patient satisfaction with outpatient surgery. The key to maintaining safety standards involves careful monitoring for potential complications, which, as the data shows, are largely identifiable during the immediate postoperative period.

Although the advantages of outpatient care are significant, there are notable challenges and limitations. The scope of procedures suitable for outpatient treatment is inherently limited

by factors such as the complexity of the procedure and the patient's medical condition. Moreover, the successful implementation of outpatient care requires a specialized infrastructure, trained personnel including anesthesia and nursing, and favorable regulatory and reimbursement environments. These prerequisites highlight the need for ongoing investments in outpatient facilities and a supportive policy framework.

The transition towards outpatient care for microlaryngoscopic procedures in Austria offers promising benefits in terms of cost, convenience, and patient satisfaction without compromising quality and safety. As the field evolves, ongoing research and adaptation will be essential to optimize outcomes for both patients and healthcare systems.

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Source of figures

Fig. 1. Generously provided by Professor Gugatschka