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Hyoid bone angle and swallowing safety post supracricoid horizontal partial laryngectomy and cricohyoidoepiglottopexy

Angulação do osso hioide e segurança da deglutição pós-laringectomia parcial horizontal supracricóidea e cricohioidoepiglotopexia

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ABSTRACT

Purpose: to investigate the possible impact of hyoid bone angulation on swallowing safety in patients undergoing supracricoid laryngectomy. **Methods:** the case series comprised 13 adults, between 48 and 79 years-old, male in its majority (n=11), within ten months or less post-supracricoid laryngectomy and cricohyoidoepiglottopexy. All volunteers were submitted to videofluroscopy at rest and during swallowing of 5 ml of thin fluid, 5 ml of pureed consistency and dry solid food. Images were captured in lateral view. The hyoid angle was taken at rest and defined by two lines: a tangent to the upper margin of the body of the hyoid bone and a horizontal line, tangent to the lowest point of its lower margin. The aspiration was assessed using the scale developed by Rosenbek et al. (1996). **Results:** five cases had silent aspiration and eight had no aspiration. In the group with silent aspiration, only one individual had both arytenoid cartilages preserved, while all individuals had the hyoid bone angle below 60º. In the group without aspiration, five individuals had both cricoarytenoids preserved, while all cases had the average hyoid bone angle above 60º. **Conclusion:** the hyoid bone being at an angle greater than 60º seemed to increase the protection of the lower airways, promoting a safer swallowing mechanism.

Keywords: Deglutition disorders; Hyoid bone; Laryngectomy; Radiology; Rehabilitation

RESUMO

Objetivo: investigar o possível impacto da angulação do osso hioide na segurança da deglutição de pacientes submetidos à laringectomia supracricóidea. **Métodos:** série de casos de 13 adultos, entre 48 e 79 anos, majoritariamente homens (n=11), submetidos à laringectomia supracricóidea em pós-operatório inferior ou igual a dez meses. Realizaram videofluoroscopia da deglutição de 5 ml de líquido fino, 5 ml de alimento pastoso e sólido, em livre oferta. A medida do ângulo do osso hioide foi definida por duas linhas: uma tangente à margem superior do corpo do osso hioide e uma tangente ao ponto mais inferior de sua margem inferior, paralela ao plano horizontal da imagem. O desfecho de aspiração durante o exame seguiu a escala desenvolvida por Rosenbek et al. (1996). **Resultados:** Dos 13 pacientes, 5 apresentaram aspiração silente e 8 não apresentaram aspiração. Dos 5 indivíduos com aspiração, apenas 1 manteve preservadas ambas as cartilagens aritenoides em sua reconstrução e a angulação do osso hioide foi abaixo de 60º, em todos os casos. Dos 8 indivíduos sem aspiração laringotraqueal, a maioria (n=5) apresentava as duas cartilagens aritenoides em sua reconstrução e a angulação do osso hioide foi acima de 60º, em todos os casos. **Conclusão:** uma angulação maior que 60º do osso hioide parece favorecer a proteção das vias aéreas inferiores e promover maior segurança do mecanismo de deglutição.

Palavras-chave: Transtornos da deglutição; Osso hioide; Laringectomia; Radiologia; Reabilitação

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INTRODUCTION

Supracricoid partial laryngectomy (SCL) involves partial resection of the epiglottis, complete removal of thyroid cartilage, vocal and ventricular folds, maintaining one or both arytenoid cartilages, which, with the epiglottis and the cricoid cartilage, constitute the neoglottis[1,2]. The reconstruction is carried out by cricohioidopexy (CHP) or cricohioidoepiglotopexy (CHEP)[1,3].

SCL-CHEP has been recommended as a treatment for tumors of the larynx, with satisfactory functional results in the postoperative period[2,4,5]. Among his sequelae, dysphagia is one of the most common disorders, characterized by aspiration, silent or not, causing pulmonary complications and death[5-7].

Dysphagia usually reduces the motivation to eat and risk nutritional and respiratory conditions[4,5]. Videofluoroscopy is a gold standard imagen examination, which allows a detailed analysis of the food process in all phases: preparatory, oral, pharyngeal and esophageal phase[5,8,9].

Recent researches have investigated relationships between post SCL-CHEP and the presence of dysphagia. However, descriptive studies of swallowing and the aspects that determine its dynamics, especially related to the positioning and displacement of the hyoid bone are rare in the literature[5,8,9]. The objective of this study was to investigate the possible impact of the hyoid bone angulation in the safety of swallowing in patients undergoing laryngectomy supracricoid.

METHODS

Observational cross-sectional study approved by the Ethics Committee in Research by the Federal University of São Paulo (opinion nº 1119/04). All the volunteers signed the Free and Informed Consent Form and were enrolled in the Head and Neck Surgery Section of Hospital São Paulo.

Patients diagnosed with laryngeal neoplasia, submitted to SCL-CHEP, recruited through the service flow in routine tests stored in medical records were included. Patients with active disease at the time of the evaluation, under 18 years of age and those who underwent another surgical procedure in the laryngeal region were excluded.

Thirteen patients with histopathological of squamous cell carcinoma, T3 stage, absence of lymph node involvement or metastasis, operated by the same surgical team, having undergone neck dissection and not undergoing radiotherapy or chemotherapy, were evaluated.

The patients underwent swallowing videofluoroscopy in a post-surgical period of less than ten months[8,10]. At the time of the radiological examination, they ate orally, without restrictions and without complaints of swallowing or a history of pneumonia.

A Siemens Axion X-ray device (500 mA, 150 kv automatic, 30 frames / second) was used, with a seriograph and closed recording circuit. The exams were edited in the Cyberlink Power DVD9 program, for frame-by-frame analysis and screen image capture.

The patients were examined in a left lateral orthostatic position, in rest and during swallowing of thin liquid (5 ml in syringe - solution of barium sulfate gel 100% in ⅔ of water); pasty food (5 ml in spoon - ⅓ barium sulfate gel 100% in ⅔ of petit suisse yogurt) and solid (¼ in wafer biscuit soaked in 100% barium sulfate gel). The presence of aspiration was assessed using the Penetration and Aspiration Scale by Rosenbek et al.[5,11].

The hyoid angulation was measured in images at rest, using the Image J program (National Institute of Health). The frame selected for analysis was defined by its quality and feasibility of clear visualization of the hyoid bone. The angle was defined by two lines: one tangent to the upper margin of the hyoid body and another tangent to its lower margin, parallel to the horizontal plane of the image (Figure 1). The angle from these two lines was automatically calculated using the program mentioned above. The values were compared descriptively between patients without and with tracheal aspiration.

RESULTS

Thirteen patients were evaluated: 11 men (84.61%) between 51 and 79 years old,7 (53.85%) aged over 65 years, and 2 women (15.39%) aged 73 and 74 years (Table 1).

Regarding swallowing, 8 patients (61.54%) had no tracheal aspiration and 5 (38.46%) had silent aspiration (Table 1).

All 5 patients with aspiration presented hyoid angulation below 60º (mean = 53.87º ± 6.26); 1 of them (20%) maintained the two cricoarytenoid units in their reconstruction. On the

Table 1. Characterization of the sample (n = 13), angulation of the hyoid bone and presence tracheal aspiration

Patient	Age (years)	Gender	Number of Arytenoids	Angulation of hyoid (in degrees)	Tracheal Aspiration
1	51	male	1	45	yes
2	48	male	1	50.11	yes
3	73	female	1	55.38	yes
4	69	female	2	59.37	yes
5	79	male	1	59.5	yes
6	67	male	1	60.57	no
7	51	male	2	67.03	no
8	68	male	2	69.29	no
9	66	male	2	69.99	no
10	58	male	2	71.18	no
11	57	male	2	84.37	no
12	69	male	1	91.88	no
13	74	male	1	94.76	no

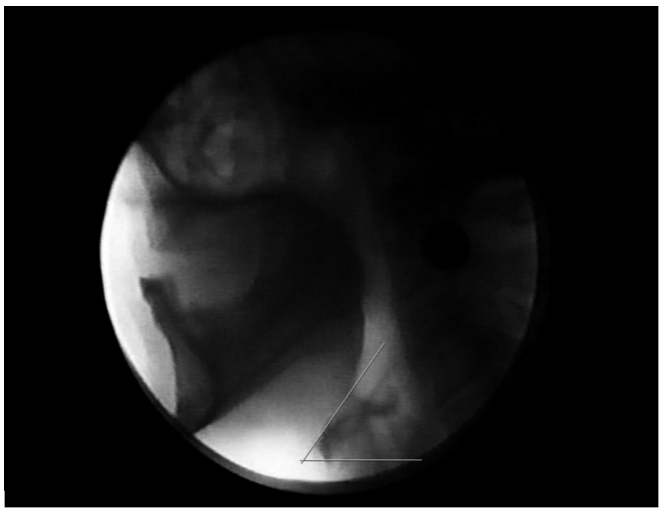

Figure 1. Angulation of the hyoid bone

other hand, the 8 patients without aspiration presented hyoid bone angulation above 60º (mean = 76.13º ± 12.51), 5 of which (62.5%) maintained both arytenoids (Table 1).

DISCUSSION

SCL-CHEP is considered an alternative to other more aggressive treatments, such as exclusive radiotherapy and total laryngectomy[1-3]. The preservation of the two cricoarytenoid units seems to favor the swallowing mechanism, since this characteristic was observed in five of the eight of the cases without aspiration (62.5%). The resting position of the hyoid bone at angulation greater than 60º also seemed to help protect the lower airways, being observed in all cases without aspiration. All individuals in this study had exclusive oral nutrition and hydration, without complaints to the swallowing or pulmonary complications. Despite this, we detected aspiration in a significant number of patients (five out of 13, 38.46%), which reinforces the importance of videofluoroscopic evaluation.

The highest occurrence of elderly men is consistent with the profile of this population described in the literature[2,4-7,9,12]. Regarding the age group, seven patients (60%) were seniors. The presence of factors related to presbyphagia, such as calcification of the cartilage, less muscle strength, reduced vascularity and greater slowness in healing, may have interfered with the postoperative result[13].

SCL-CHEP is indicated for the treatment of tumors in the intermediate and advanced, which justifies the prevalence of individuals with T3 staging[2,4,6,7,9]. Tracheal aspiration is a common clinical outcome, with incidences close to 40%, even in individuals without complaints[5,7,9]. The new sphincter mechanism of the nasopharynx is given by the approximation of one or two cricoarytenoid units (rotating anteroinferiorly) and by the movement of the remaining epiglottis (sloping posteroinferiorly)[14]. Restrictions on mobility of this new biomechanics can be aggravated by factors linked to the aging, such as calcification of the remaining cartilages and stiffening of their joints.

There is no consensus regarding the functional impact of maintaining a or two arytenoids. However, there are reports of better recovery and swallowing more effective with the preservation of both arytenoids[2,6,12,15]. Although the reduced number of patients in this study did not allow definitive considerations, all individuals who had two cricoarytenoid units showed better functional results and this is likely to be a protective factor for lower airways[9,15]. These are mobile units, due to the preservation of the laryngeal nerve, making it possible to perform the adduction movement, together with the remaining structures[5,7,15].

There is a consensus in the literature that an incomplete laryngeal closure affects swallowing safety[5]. We consider that the hyoid angulation in the neolaring may be a contributing factor to the closure of the airway. In this study preliminary, angles greater than 60º seem to have contributed to the occlusion of neoglottis, which is covered by the base of the tongue at the moment of maximum constriction swallowing, favoring the closure of the laryngeal vestibule and protecting against aspiration.

Due to the presence of high rates of silent aspiration and functional impairments, speech therapy rehabilitation aims to maximize the safety and functionality of the new swallowing standard (mobility, vigor and duration). SCL-CHEP directly affects the pharyngeal phase of swallowing and techniques vocal rehabilitation and orofacial motricity[14] can facilitate the development of compensations.

Techniques such as counter-resistance and tongue lateralization can favor the ejection and transit of the bolus[5,7,13,15]. Swallowing with effort stimulates the contact of the base of the tongue with the posterior pharyngeal wall at the moment of ejection bolus[5,9,14], a critical factor in post SCL-CHEP rehabilitation[14]. Techniques to promote greater opening of the upper esophageal sphincter allows the transit of the bolus and supraglottic and super supraglottic maneuvers stimulate a greater range of movement and longer duration of neoglottis closure. Endoscopic injections of filling in the region of the cricoarytenoid units, or in the upper face of the ring of the cricoid, and injections of fat that correct the tissue loss at the base of the tongue[5], are also available resources.

The study had some limitations, the analysis of bone angulation hyoid was performed at rest and this measure does not necessarily represent the angulation assumed during swallowing. The functional result is multifactorial and depends on several aspects, such as individual anatomical variations of patients, surgical technique or manipulation, postoperative complications, healing process, adaptation of the remaining structures and interaction between the phases of swallowing. It is important to consider that many of these aspects, difficult to control and analyze, were not part of the objective of the proposed study and do not devalue the findings described here.

The expansion of the sample in a second phase of this study can bring clearer results regarding the angular positioning of the hyoid. The results demonstrated here indicated that the maintenance of this angle above 60º after reconstruction can contribute to the safety of swallowing, aiding in the rehabilitation process and improving the quality of life.

CONCLUSION

The positioning of the hyoid at an angle greater than 60º seems to favor the swallowing functionality in terms of safety, that is, it helps to protect of the lower airways in patients undergoing SCL-CHEP.

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