



# Laryngeal Framework Reconstruction Using Titanium Mesh Following Partial Laryngectomy for the Treatment of a Giant Cell Tumor of the Larynx

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## Abstract

**Background:** Giant Cell Tumors of the Larynx (GCTL) are quite rare. Here, we have presented a case of GCTL; this patient should have received a total laryngectomy but instead received a partial laryngectomy, and titanium mesh was used to reconstruct the laryngeal framework.

**Methods:** The clinical, imaging, and pathological characteristics of one GCTL case was presented. The procedure for the reconstruction with titanium mesh and the postoperative results were reported.

**Results:** The use of titanium mesh to reconstruct the defect in the laryngeal framework was successful. No postoperative complications occurred, and laryngeal function, including swallowing, breathing, and speech, was well preserved. The patient was free of disease after a 1-year follow-up period.

**Conclusion:** This case demonstrated that it was feasible and appropriate to use titanium mesh to reconstruct a laryngeal framework defect following a partial laryngectomy for the treatment of a GCTL derived from the thyroid cartilage.

**Keywords:** Giant cell tumor of the larynx (GCTL); Titanium mesh; Laryngeal framework reconstruction; Partial laryngectomy; Thyroid cartilage

## Introduction

Giant cell tumors are benign but locally aggressive tumors, which account for 5% of all primary bone tumors. These tumors predominantly arise in the epiphyses of long bones around the knee in individuals in their 20s to 40s [1]. However, Giant Cell Tumors of the Larynx (GCTL) are quite rare, and surgery is recommended as the chief treatment modality for these tumors. The surgical options consist of either a total laryngectomy or a partial laryngectomy, depending on the extent of the lesion. Additionally, radiotherapy and chemotherapy can be used as adjuvant therapy. In this paper, we have presented a new case of a GCTL, where the lesion involved the bilateral thyroid cartilage alae. According to the extent of the tumor, this patient should have been administered a total laryngectomy. However, we performed a partial laryngectomy and reconstructed the laryngeal framework with titanium mesh. The approach yielded a favorable outcome, and the patient was free of disease at a 1 year follow-up period after surgery. To the best of our knowledge, this therapeutic technique has not been previously described for the treatment of GCTL.

## Case Presentation

### Disease history and preoperative evaluation

A 57-year-old man was seen at our hospital for a left anterior neck mass, which had been palpable for 1 month. Seven years previously, he had received a left thyroid lobectomy at his local

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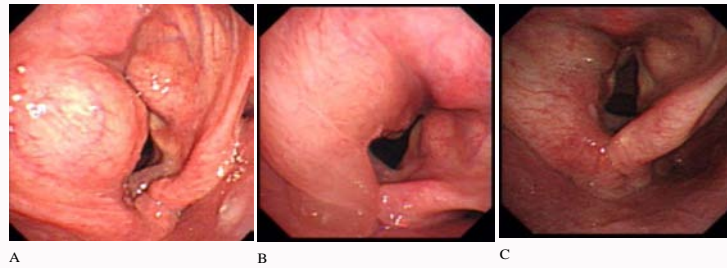
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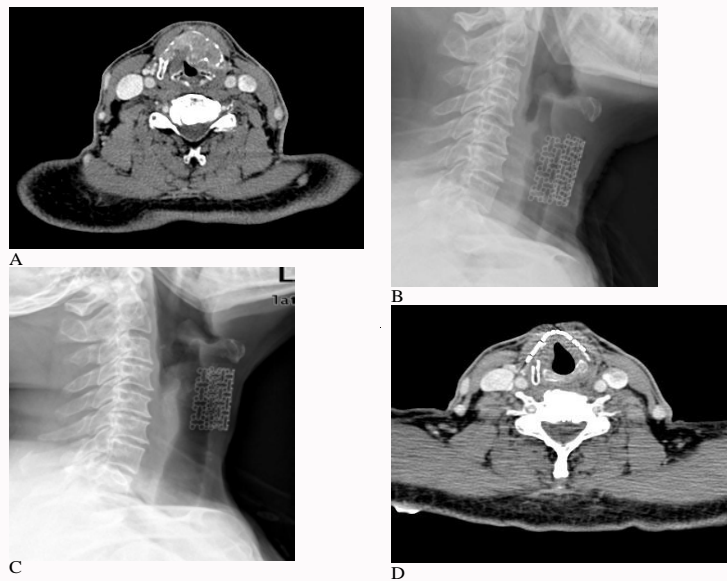
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**Figure 1:** (A) Submucosal swelling of the patient's laryngeal lumen especially left side revealed by a fiberoptic laryngoscopy. (B) Submucosal swelling of the patient's laryngeal cavity disappeared mostly revealed by a fiberoptic laryngoscopy at eighth postoperative day. (C) Submucosal swelling of the patient's laryngeal cavity disappeared revealed by a fiberoptic laryngoscopy at a 1-year follow-up postoperatively.



**Figure 2:** (A) Axial CT scan of the larynx showing cortical expansion and destruction at the bilateral alae of the thyroid cartilage. (B) Lateral X-ray of the larynx at eighth postoperative day indicated the titanium mesh fastened well without displacement and deformity. (C) Lateral X-ray of the larynx at a 1-year follow-up postoperatively indicated the titanium mesh fastened well without displacement and deformity. (D) Axial CT scan of the larynx showed the patient was free of disease, the titanium mesh fastened well without displacement and the laryngeal lumen was patent at a 1-year follow-up postoperatively.

hospital. The postoperative pathological examination indicated a diagnosis of anaplastic thyroid carcinoma (giant cell subtype). This patient had not experienced any symptoms except hoarseness that had not improved since receiving that procedure. He had been in remission for 7 years before he had incidentally discovered this mass 1 month prior to his visit to our hospital.

A physical examination revealed a palpable and firm mass on the left anterior portion of the neck, which measured approximately 3 cm in diameter and had a clear boundary with no tenderness. No enlarged lymph nodes were palpable. He was otherwise generally healthy, and his Eastern Cooperative Oncology Group (ECOG) performance status was 0.

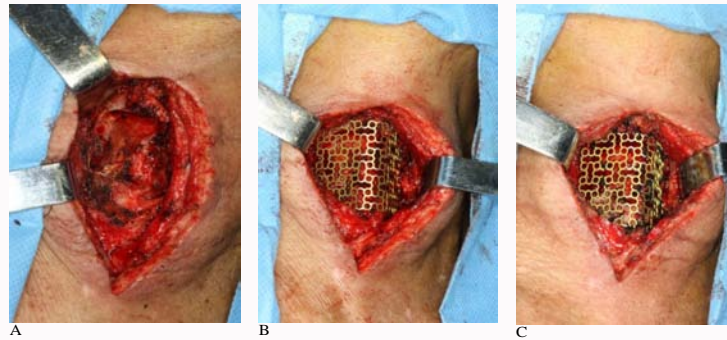
An endoscopy of the larynx revealed a 3 cm × 3 cm submucosal swelling in the left laryngeal lumen (Figure 1A). A Computed Tomography (CT) scan of the larynx showed that the tumor arising from the left ala of thyroid cartilage with cortical expansion and destruction and involving the right ala of thyroid cartilage (Figure 2A), the cricoid cartilage was invaded in a small area; the endolaryngeal tissues were pushed medially, and the perilaryngeal spaces were also involved. Laboratory results from analyses of serum calcium, phosphate, and alkaline phosphatase levels, thyroid function and the parathyroid hormone assay were within normal limits. To obtain a

definitive diagnosis, an open incisional biopsy was performed, and the pathological results indicated a borderline giant cell tumor.

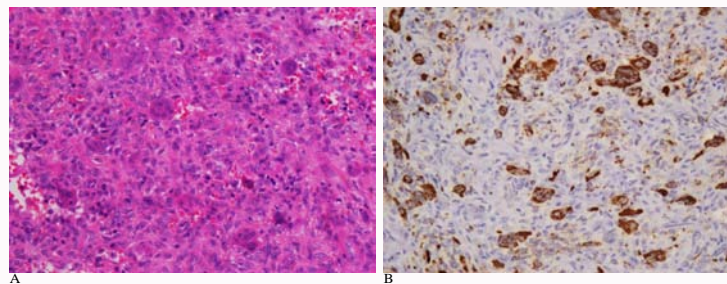
**Operative procedure**

According to the extent of the tumor, a total laryngectomy should be performed on this patient whose tumor has involved the bilateral alae of the thyroid cartilage. However, the patient refused a total laryngectomy because of the potential sequelae. The benign nature and favorable prognosis of GCTL allows for a more conservative resection margin, compared to a malignant tumor. After considering the factors involved in this case, we decided to perform a partial laryngectomy and to reconstruct the laryngeal framework using titanium mesh, and this procedure effectively minimized the damage associated with a total laryngectomy.

Intraoperatively, the tumor was a yellowish-grey mass without clear boundaries that was centered along the thyroid cartilage but had invaded the adjacent tissues of the thyroid cartilage. The tumor involved most of the bilateral thyroid cartilage alae, especially the left side. We attempted to completely resect the tumor, and we excised the anterior half of the left vocal cord and a portion of the left false vocal cord *via* a laryngofissure. This procedure produced a large defect that included the left ala and most of the right ala of the thyroid



**Figure 3:** (A) A large laryngeal defect including bilateral alae of the thyroid cartilage intraoperatively after partial laryngectomy. (B) The titanium mesh was molded into “V” shape to fit the contour of thyroid cartilage. (C) The titanium mesh was fixed to the residual thyroid and cricoid cartilages and the inner soft tissue of thyroid cartilage was attached with silk suture.



**Figure 4:** (A) Giant cell tumor of the larynx (GCTL) with numerous multinucleated osteoclastic-like cells. (H & E, original magnification  $\times 200$ ). (B) Multinucleated osteoclastic-like cells stained positive with CD68. (IHC, original magnification  $\times 200$ ).

cartilage and adjacent soft tissue (Figure 3A), and was intraoperatively challenging to reconstruct.

We selected a suitable titanium mesh (Stryker Leibinger Dynamic Mesh, Freiburg, Germany; 1 mm in thickness), which had been trimmed to fit the defect of the thyroid cartilage (approximately 4 cm  $\times$  6 cm), and was molded into a “V” shape to resemble the thyroid cartilage (Figure 3B). To achieve reliable fixation, we fixed the mesh to the remaining thyroid and cricoid cartilages with silk suture (Figure 3C). Next, we attached the residual laryngeal soft tissues to the titanium mesh to cover the inner surface of the mesh and avoid its exposure into laryngeal lumen, and used the residual strap muscle to cover the outer surface of the mesh. Finally, a tracheostomy was performed to prevent airway obstruction.

### Pathology

The microscopic examination revealed diffuse, multinucleated osteoclast-like giant cells throughout the tumor, which were surrounded by mononuclear ovoid or spindle-like cells (Figure 4A). Although a portion of the cells proliferated actively and mitotic figures of the mononuclear cells could be seen the presence of a malignant tumor was excluded based on the absence of atypical cells. Furthermore, a non-neoplastic osteoid matrix deposition was observed from the specimen.

Immunohistochemically, all tumor cells stained negative for CK, TG, TTF-1, and S100. Multinucleated cells were positive reaction for CD68 (Figure 4B). The diagnosis of GCTL was made on the basis of the multinucleated osteoclast-like giant cells, and mononuclear ovoid cells confirmed by microscopy and immunohistochemistry, as well as the position of the tumor.

To determine whether the two pathological diagnoses given

to this patient were identical, we reviewed the pathological slides that had been collected 7 years previously. We determined that the previous pathological diagnosis was identical to the postoperative diagnosis in our hospital, as they had both indicated a giant cell tumor. Therefore, we inferred that the patient had suffered from GCTL 7 years previously but had been misdiagnosed as having an anaplastic thyroid carcinoma (giant cell subtype). The tumor likely recurred during this time due to the initial improper treatment. To our knowledge, this patient represents the first case of a recurrent GCTL.

### Postoperative Result

The surgical procedure was successful and did not result in any intraoperative or immediate postoperative complications. No episodes of aspiration or dyspnea were observed after surgery, and we advised the patient to eat a normal diet on the third postoperative day. The tracheostomy tube was removed on the fifth postoperative day. Radiographic and endoscopic evaluation of the larynx were performed on the eighth postoperative day, and these showed no evidence of laryngeal stenosis and indicated that the titanium mesh had not been displaced, deformed, or exposed (Figure 1B, 2B). The patient made an uneventful recovery after his surgery, and he did not experience obvious impairments in breathing, swallowing, or olfactory functions. His voice remained hoarse, as it had been preoperatively, but could easily be understood. The patient was discharged on the ninth postoperative day.

Because the extent of the lesion was extensive, it involving not only the bilateral thyroid cartilage alae, but also the adjacent soft tissue, we advised the patient to undergo radiotherapy postoperatively. However, the patient refused to accept the radiation treatment. Nonetheless, the patient was free of disease one year after surgery.

and did not experience any problems related to daily life activities. A recent CT scan and an endoscopy examination of the larynx showed that the laryngeal lumen was well maintained and did not exhibit stricture or necrosis and that the titanium mesh was not displaced deformed or exposed to the laryngeal lumen (Figures 1C, 2C, 2D).

## Discussion

Giant cell tumors represent a type of neoplasm that has a tendency to exhibit locally aggressive behavior. Approximately 2% of GCTs arise in the head and neck, especially in the mandible, skull base, and paranasal cavities [2]. However, GCTL is very rare. Thus far, only 33 cases of GCTL have been documented in the literatures [2-6]. These GCTL most commonly originate in the thyroid cartilage as compared to the cricoid cartilage or the epiglottic cartilage.

Giant cell tumors of the long bones are a type of osseous neoplasm and demonstrate a female predilection [1]. In contrast, GCTL have a male predilection with a male to female ratio of 10:1, according to the published literature [2]. The reasons for this gender distribution remain to be determined, although the predilection for males may be associated with earlier endochondral ossification of the laryngeal skeleton in men [4]. The average age of the previous reported 33 patients with primary GCTL is 41.4 years, and this age range from 23 to 62 years [2-6]. In our case, the GCTL was first discovered when the patient was 50 years old and was definitively diagnosed when the tumor recurred 7 years later.

The early symptoms of a GCTL are similar to those of other laryngeal tumors and include hoarseness, the presence of a neck mass, sore throat, and dysphagia, and these symptoms may present as early symptoms of GCTL, depending on the location and extent of the tumor. When the disease advances or the tumor becomes enlarged, these symptoms may develop further and dyspnea may occur.

Radiological examinations, especially MRI or CT scan, are useful for revealing the position and extent of a GCTL. However, imaging studies cannot differentiate GCTL from other tumors. Thus, the definite diagnosis of GCTL should be made according to the results of histopathological and immunohistochemical examination. A variety of laryngeal neoplasms may contain giant cells and can cause diagnostic dilemma. The differential diagnosis of GCTL includes aneurismal bone cyst, malignant fibrous histiocytoma, anaplastic thyroid carcinoma (giant cell subtype), osteosarcoma, and sarcomatoid carcinoma with osteoclast-like giant cells, et al.

The treatment for GCTL remains controversial, and the currently available treatment modalities include surgery, radiotherapy, chemotherapy and combined therapy. Based on the reported treatment of 33 cases of GCTL presented in the literature, the partial laryngectomy is the most common surgical procedure used by most surgeons, followed by a total laryngectomy. Radiotherapy can be used as adjuvant therapy postoperatively, although chemotherapy is seldom applied for the treatment of GCTL [2-6]. Additionally, complete resection of the tumor is recommended as the optimal treatment for GCTL.

Sarcomatous transformation has been reported post-radiotherapy in patients with giant cell tumors of bones [3]. This transformation represents a major concern related to the use of radiation therapy, although no cases have been reported in GCTL patients. Furthermore, chemotherapy may serve as an adjuvant treatment, but it is also may be unnecessary for the treatment of GCTL.

Therefore, due to the complicated anatomy of the neck, which is closely associated with breathing, swallowing, speech, and olfactory function, surgeons should attempt to preserve or restore these functions when performing tumor ablation to improve the Quality of Life (QOL) of patients.

A total laryngectomy is an intensive, traumatic operation that destroys the physical structure and function of the upper respiratory and alimentary tracts. The procedure can cause irreparable and obvious impairments in speech, breathing, and olfactory function, and it can have negative effects on appearance. As an alternative, the reconstruction of laryngeal framework can reduce functional damages and improve the patient's QOL. The reconstruction procedure for laryngeal framework using titanium mesh was used successfully for patients with laryngeal carcinoma, but has not been performed on patients with GCTL [7]. In addition, there have been no reports of GCTL recurrence, regardless of the therapeutic option chosen and even when there were pathologically positive margins [8]. The favorable prognosis may be attributed to the benign nature of GCTL.

Consequently, for GCTL patients with a large tumor or a wide extension, a partial laryngectomy with laryngeal framework reconstruction should be preferable to a total laryngectomy, when attempting to achieve a complete resection. Thus, this approach attempts to improve the patient's QOL while obtaining a similar outcome and using a less aggressive procedure. As we had anticipated, the patient in this study recovered rapidly after the operation and did not experience any obvious alternations to his daily activities or QOL. Moreover, there has been no evidence of tumor recurrence after one year of follow-up.

## Conclusion

GCTL is a type of exceedingly rare neoplasm that arises in the larynx. In this paper, we have presented the first recurrent case of GCTL with extensive invasion, which should have been treated with a total laryngectomy. However, we performed a partial laryngectomy with laryngeal framework reconstruction using titanium mesh to preserve laryngeal function. This surgical method had not been previously described for cases of GCTL. In this case, the treatment modality yielded a favorable outcome. Thus far, the patient has been free of disease for one year. However, long-term follow-up and additional cases are necessary to evaluate the therapeutic effects and benefits of this novel treatment method.

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