

# Usefulness of Permanent Tracheostoma in Chronic Brain Injured Patients: A Case Series

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Patients with severe neurological deficit, such as hypoxic ischemic injury, cerebral infarction, and traumatic brain injury, often show comatose mental status and require maintenance of long-term tracheostomy for pulmonary toileting. However, several complications, which are mostly related to the cannula, invariably occur. Permanent tracheostoma is a short, skin-lined, noncollapsing, self-sustaining opening by suturing the denuded skin lining to the margin of the tracheal stoma. This tube-free method is a useful alternative to make long-term airway without tube-related complications in chronic diseases, such as obstructive sleep apnea, and laryngeal cancer, however, it has not yet been reported in chronic brain injured patients. This case report illustrates 3 cases of vegetative patients in our rehabilitation clinic who underwent successful procedure of permanent tracheostoma. Permanent tracheostoma has some benefits associated with the free of tube-related complications, and can be considered as a useful alternative way for chronic brain injured patients with long-term tracheostomy.

**Key Words:** Permanent tracheostoma, chronic brain injury, tracheostomy, rehabilitation

## INTRODUCTION

Patients with severe neurological deficit, such as hypoxic ischemic encephalopathy, cerebral infarction, and traumatic brain injury, present compromised breathing, coughing, and pulmonary toileting. They usually require maintenance of long-term tracheostomy tube.<sup>1,2</sup> However, several serious complications invariably arise from the long-term maintenance of a tracheostomy tube. These complications, such as tracheal granuloma, stomal granuloma, tracheotomy tube obstruction, and tracheoesophageal fistula, are mostly related to the cannula.<sup>3-6</sup> Especially for the quadriplegic vegetative patients in a rehabilitation setting, accidental or excessive movement of the tube during turning, suctioning, ventilator connection and disconnection may cause additional side effects, such as reflex coughing, agitation, and abnormal posturing.

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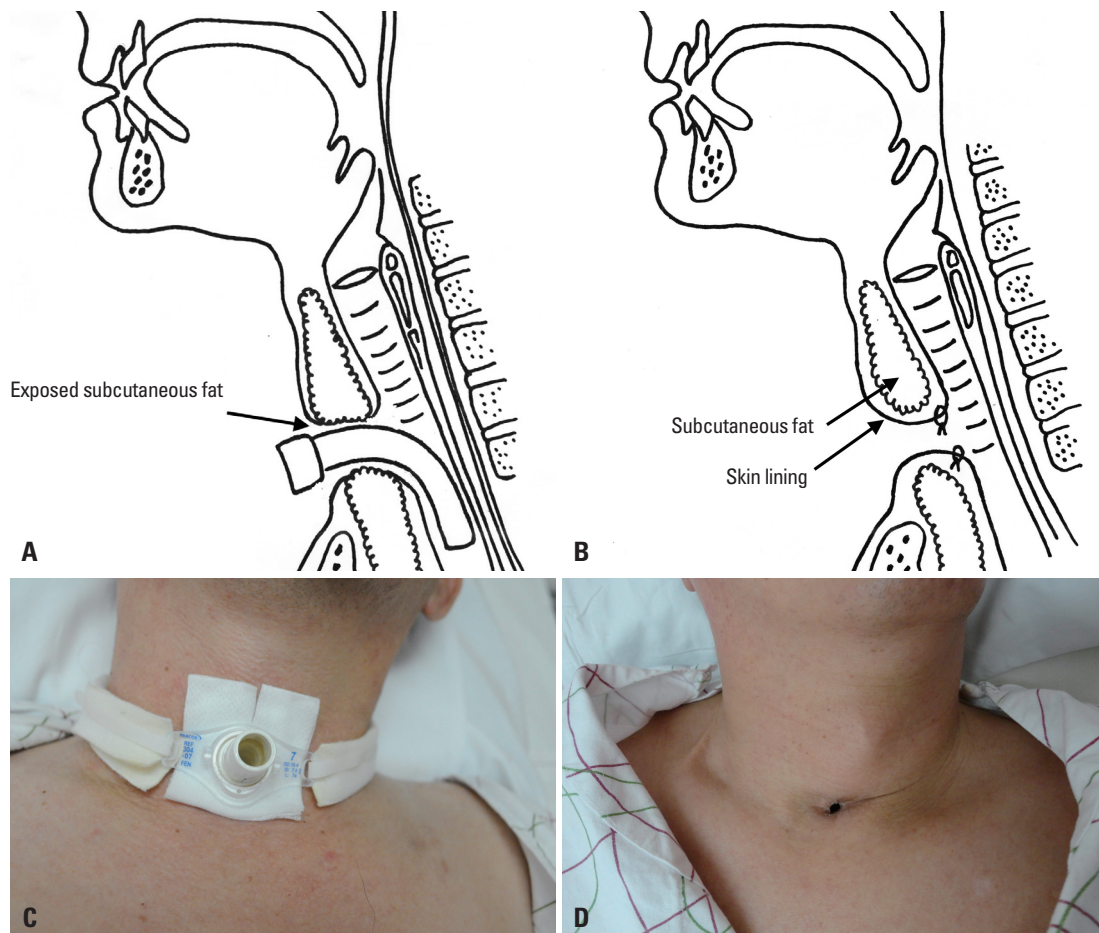
Permanent tracheostoma is a surgical procedure intended to provide the trachea with a long-lasting functional opening to the surface, and free from the usual problems and complications associated with a long-term conventional tracheostomy (Fig. 1A).<sup>7-9</sup> It involves the incision into the trachea and suture the denuded skin lining to the margin of tracheostoma for making a self-sustaining tracheal opening (Fig. 1B). This long-term or permanent tracheostomy has been recommended, when a stoma is required for months or years, or for indefinite periods, and has been performed in chronic disease, such as severe obstructive sleep apnea, bilateral vocal cord paralysis, and laryngeal cancer.<sup>7,9-12</sup> However, it has not yet been reported in chronic brain injured patients with long-term tracheostomy, who had cognitive deficit, and weakness of four extremities, as well as poor head and neck control due to their quadriplegic status.

We, therefore, report 3 cases of quadriplegic patients with chronic brain injury in our rehabilitation clinic that underwent successful procedure of permanent tracheostoma as a

good alternative method for conventional tracheostomy and were free of tube-related complications after the procedure.

## CASE REPORT

Three patients with chronic brain injury in our rehabilitation clinic had been maintained with long-term tracheostomy tube for pulmonary toileting. General characteristics of the patients are described in Table 1. Several months after tracheostomy, a tube was changed to an uncuffed, unfenestrated tube because saliva aspiration was not definite (Fig. 1C). Annual airway examinations were done with consultation of otorhinolaryngology department, and two patients showed suprastoma granulation tissue. Since they needed maintenance of long-term tracheostomy, permanent tracheostomy procedure was done simultaneously with the granulation removal operation (Fig. 1D). Case 1 patient did not develop airway complications, but underwent the proce-



**Fig. 1.** A schematic comparison of conventional tracheostomy and permanent tracheostoma and photographs of case 1 patient. (A) A conventional tracheostomy is not covered with skin between tube and stoma, which makes high risk of inflammation and infection due to exposed subcutaneous tissue. (B) A permanent tube-free tracheostoma is covered with skin lining and not contact with tube. (C) A picture of before, (D) after permanent tracheostoma of case 1 patient.

**Table 1. General Characteristics**

	Case 1	Case 2	Case 3
Sex/age	M/63	M/49	M/57
Diagnosis	Quadriplegia due to hypoxic brain injury	Quadriplegia due to subdural hemorrhage	Quadriplegia due to hypoxic brain injury
Onset	2003-5-20	2007-5-19	2011-5-7
JFK-CRS	9	12	4
K-MMSE	Uncheckable	Uncheckable	Uncheckable
MBI	4	4	4
Feeding method	PEG	PEG	NG tube
Mechanical ventilator use	No	No	No
Spasticity (MAS)	Grade 3	Grade 2	Grade 2
First tracheostomy	2006-12-28	2007-5-31	2011-5-11
Permanent tracheostoma (duration, months)	2011-12-23 (60)	2009-3-16 (22)	2012-5-4 (12)
Type of tube	Uncuffed unfenestrated	Uncuffed unfenestrated	Uncuffed unfenestrated
Tube change per month	2	2	1
Cost of tube per month (US dollar)	45	45	30

JFK-CRS, JFK coma recovery scale; K-MMSE, Korean Mini-Mental State Examination; MBI, Modified Barthel Index; PEG, Percutaneous Endoscopic Gastrostomy; NG, Naso Gastric; MAS, Modified Ashworth Scale.

**Table 2. Comparing before and after the Procedure of Permanent Tracheostoma**

	Case 1	Case 2	Case 3
Airway complication (pre/post)	No/no	Granulation/no	Granulation/no
Mean frequency of upper respiratory infection per yr (pre/post)	1.5/1.5	4.5/1.5	5/none
Mean frequency of suction per day (pre/post)	35/20	20/10	55/20
Foul odor from stoma	Decreased	Decreased	Decreased
Mean frequency of reflex cough (pre/post)	No/no	Yes/decreased	No/no
Mean frequency of increased stiffness after permanent tracheostoma	Decreased	No change	Decreased

ture for prevention of tube-related complication, because he also needed long-term maintenance of tracheostomy. All the operation was performed under the caregivers' consent. After the procedure, no airway complications were found on annual examination. According to caregiver's reports, mean frequencies of suctioning, reflex cough and increased stiffness caused by tube irritation during changing position were reduced, although the grade of spasticity was not changed, and hygiene of stoma site was improved after making the permanent tracheostoma (Table 2). Caregivers reported that anxiety and difficulty with management of stoma were relieved, and they were very much satisfied with the procedure.

## DISCUSSION

The main benefit of this permanent tracheostoma is that patients are free of risk for complications caused by tracheostomy tube itself. First, there is no risk of tube displacement,

which was fourth common complication of the tracheostomy, according to a previous study.<sup>3</sup> If the stoma is sustained without the tube, caregivers and patients may feel comfortable with stoma care, as also found in this study. Second, hygiene can be improved and tube obstruction from inspissated secretions can be decreased. The caregivers of this study reported decreased foul odor around the stoma site and improved hygiene, and frequency of suctioning diminished for all three patients (Table 2). Third, tracheal irritation is decreased. Structural change after tracheostomy, such as tracheal stenosis caused by the deformation in the anterior tracheal wall,<sup>8</sup> can be reduced. Also, occurrence of supra-, infra stoma granulation tissue around the inserted tube and reflex cough from the tube irritation can be reduced. Fourth, taking care of stoma is easier and there is no need to change the tracheostomy tube. This procedure lessens the burden of patients and caregivers. Fifth, cost is saved. In this study, cost of tube change for a month was about 45 US dollars for patients in cases 1 and 2, and about 30 US dollars for case 3 patient, which are equivalent to about 540 US dollars, 360

US dollars for a year, respectively (Table 1). Permanent tracheostoma brings economic benefits by making intentional tube-free stoma.

In addition to these benefits, it is possible to make a voluntary cough or speech without any device by constricting the stoma with combination of neck flexion and muscle tightening, if the tracheostomized patients are motivated and alert.<sup>9,10</sup> Stoma closure can also be done safely with local anesthesia, if neurologic recovery occurs and patients no longer need artificial airway of tracheostomy. Mechanical ventilator connection can also be connected easily with tube insertion.

Despite these benefits, the permanent tracheostoma procedure has the risk of postoperative complications such as suture line dehiscence, granulation tissue in breakdown wounds, and local infection.<sup>9</sup> Although this is an elective operation, it requires general anesthesia and wider skin incision than the standard tracheostomy. However, no late complications throughout the follow-up ranging from 6 months to more than 7 years, were reported.<sup>9</sup> In the event of emergent situations such as acute laryngospasm, tube insertion for airway management would be difficult, but there has so far not been reported.

Patients with chronic brain injury in rehabilitation clinics who need maintenance of long-term tracheostomy are usually quadriplegic status; so they cannot control themselves to avoid tube irritation due to their physical and mental status. These patients are inevitably dependent on caregivers. The risk of late complication is directly related to the tube itself, and bound to be a burden to caregivers who take care of the stoma and tube. If a patient is not dependent on mechanical ventilator, which needs tube for ventilator connection, nor dependent on the cannula cuff with no high risk of

aspiration, this tube-free permanent tracheostoma is a reasonable alternative way for chronic brain injured patients, who need the long-term artificial airway, by bringing the aforementioned benefits.

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