It is a great honor and privilege to be invited to Kobe to celebrate and to participate in the 50th anniversary of the Japan Broncho-esophagological Society. I have been here before, and I have met a number of Japanese colleagues over the past 18 years. I believe that the medical and social interchanges over these years have led to very significant developments in the fields of laryngology and head and neck cancer, and I have been proud to be a part of it. The generous hospitality of my Japanese hosts, and continued interest in my work has been one of the singular highlights of my medical career.

In 1973, I began my postgraduate training in Otolaryngology at Northwestern University in the city of Chicago. This was an important time to initiate my studies because of the Centennial Congress on Laryngeal Cancer that was held the following year in Toronto to commemorate the laryngectomy of Billroth and to share ideas and results of investigators throughout the world. It was hoped, that a “great leap forward” would result from this important congress. My professor, George Sisson, introduced the ideas of “reconstructive laryngectomy” developed by the Italian investigators, M. Arslan, I. Serafini, and M. Staffieri, which were presented at the Canadian Congress for the first time in North America. I observed Dr. Sisson’s adaptations of these procedures, as well as his efforts directed to prosthetic rehabilitation of the total laryngectomy for a number of years, before leaving to develop my own career in otolaryngology at the Indiana University in Indianapolis.

During my early years in Indiana, I continued to investigate the reconstructive laryngectomies as well as some prosthetic and shunt procedures. It became evident that there were no superior techniques, and that consistent results were not possible. This also became evident to other American investigators. The one hundred year history of laryngeal cancer surgery was characterized by many shunt procedures, tracheal devices and valves, and near total laryngectomies. It was also a period of parallel development of radiotherapeutic methods, which when not successful, challenged the best efforts of surgeons and patients.

By 1965, the late Professor Asai, of Kobe University, reported a three stage method for alaryngeal speech rehabilitation that used a skin tube tracheopharyngeal shunt construction (Fig. 1, 2). Asai reported good phonation, but in the 72 cases, there was
disruption of the shunt in 10 cases, stenosis in 10 cases, and aspiration pneumonia in 2 cases. In the United States, Miller working in Los Angeles, had the largest American series of patients, finding excellent speech in not more than 20% of 40 studied cases and an accompanying high incidence of salivary soiling of the airway. The results were poorer and there were more complications in radiated patients which represented a large part of the North American population of laryngectomized patients. Hirsutism in the shunts of American patients was also a significant and common drawback of the Asai procedure.

An extra-anatomic shunt was described by Taub and Spiro in 1972. This shunt decreased airway contamination, but required a mechanical link and valve system to produce speech. An esophagostoma was placed at a predetermined level in the neck following insufflation to locate the pharyngoesophageal segment for alaryngeal speech production. Insufflation testing placed the pharyngoesophageal segment at the cricopharyngeus muscle, which had been suggested by speech pathologists for the previous 50 years.

There were a number of contributions made by Conley, Briani, Sisson, and Calcaterra. Most of these were shunt procedures placed secondarily after laryngectomy to rehabilitate patients that had not been successful with the acquisition of speech by esophageal insufflation methods. Although there were often initial enthusiastic reports of the methods, long term success was limited by inability to achieve consistent results, shunt stenosis or dilatation, aspiration of pharyngeal secretion, infection, and wound breakdown.

It was against this background that the reconstructive procedures by the European investigators were received with great interest and optimism. Experience was soon acquired that continued to disappoint surgeons and patients. There was troubling aspiration and shunt dehiscence, and applying these methods to previous radiation failures was complicated by major wound problems and carotid artery exposures. Case selection remained a problem and long term disease control rates suffered in comparison to conventional total laryngectomy. It became evident by 1977, that a safer and more reliable procedure was needed, if large numbers of
laryngectomies would be served and would regain communication by speech. In fact, the loss of speech has influenced laryngeal cancer treatment, and directed patients to non surgical approaches which have risked survival in the interests of communication.

In 1978, I first became aware of the method and work of Professor M. Amatsu of Kobe (Fig. 3). His one stage surgical technique for postlaryngectomy voice rehabilitation was of great interest. It emanated from Kobe University and the department of Professor R. Asai whose own procedure was described 25 years before. Like the Asai procedure, it was a simple concept linking the airway to the esophagus by a tracheal mucosal shunt instead of the skin tube described earlier (Fig. 4). It improved on the Asai procedure because of its applicability at the laryngectomy as a one stage procedure, and it uniquely placed the shunt distal to the pharynx and inferior to the cricopharyngeus muscle. Professor Amatsu’s procedure represented an important breakthrough in laryngeal cancer surgery. It did not limit the surgical treatment of the disease, radiated patients were not excluded, the voices were effortless, and swallowing was not significantly affected.

My friendship began with Professor Amatsu...
tsu by correspondence and shared experiences by the modality of videotape. I embarked on a small series of patients in Indianapolis exploring Amatsu’s technique. My initial results were very good and were well received. A small case experience was acquired, and it became apparent, that the tracheal shunts were contracting with healing and radiation, as well as some severe stenosis, and in a few cases, leakage and soiling of the airway. The speech results were excellent, but shunt care became an increasing problem. It was apparent that in an American population, there were failures of Amatsu’s procedure that arose from anatomic differences, treatment differences, and excessive care requirements.

The need for a procedure that was built on the contributions of the Japanese investigators was apparent and a further simplification of the tracheoesophageal shunts was now at hand with the “tracheoesophageal puncture” technique that I developed and described in 1978 (Fig. 5). Applying an endoscopic technique allowed the secondary voice restorations to be done without opening the cervical tissues and encountering the possibility of infection. The midline concepts of Asai and Amatsu were preserved, and the entry point inferior to the cricopharyngeus suggested by Amatsu was also preserved. The tracheoesophageal puncture represented the shortest path for air to travel to the esophagus. The concept of midline puncture was readily applied during laryngectomy with no increase in operative time. The method of “endoscopic voice restoration” was simple, easily learned, and readily accepted.

The experience with the Amatsu method necessitated the following: maintenance of shunt patency over time and protection of the airway during swallowing. The solution to these problems was addressed by the silicone voice prosthesis (Fig. 6). This device became known as the Blom-Singer voice prosthesis, and was made available worldwide by 1980. The prosthesis is a silicone valve that is either a slit or a flap that closes by its elastic recoil preventing pharyngoesophageal regurgitation into the airway, and opens under positive tracheal pressure to conduct exhaled pulmonary air into the pharyngoesophagus for activation of the mucosa as a vibratory sound source (Fig. 7). The valves replace the glottis as a protective mechanism for the airway but do not replace the sound producing characteristics of the larynx. It also
serves to maintain the tracheoesophageal shunt patency against the forces of tracheal contraction and healing. This finding was a unique characteristic of Amatsu’s technique in that placement of the tracheal meatus through the membranous trachea takes advantage of the tendency to close rapidly and avoids fistulization or dilatation, which would result in unwanted tracheal contamination.

Another important issue raised by Amatsu’s technique and not identified in Asai’s method is pharyngeal constrictor hypertonicity. Although the ideal sound source is the pharyngoesophageal segment, introduction of air at a level inferior to the cricopharyngeus may result in a tight or hypertonic pharynx which prevents airflow from crossing the segment and producing sound in some patients. This is a finding that had not been observed regularly with previous voice rehabilitation procedures until my experience with Amatsu’s technique or with endoscopic voice restoration by tracheoesophageal puncture.

The mechanism that explains this problem is simple, and was identified earlier with the first studies of esophageal manometry. When the pharyngeal innervation is intact as in normal individuals and in some laryngectomies, approximately 40%, distension of the body of the esophagus will increase the tone in the upper esophageal sphincter and it will reduce it at the lower esophageal sphincter. This is an antireflux reflex, and if intact, will interfere with the acquisition of tracheoesophageal speech and possibly esophageal speech. It is mediated through stretching the esophageal wall and efferent motor discharges from the pharyngeal plexus produce the upper esophageal sphincter “hypertonicity” and resultant speech failure. This important observation resulted from the experience initiated by Amatsu with tracheoesophageal speech. Its recognition is now widely accepted and explains the complex problems of esophageal speech failures as well.

The management of this problem in the secondary cases is the application of pharyngeal constrictor myotomy, pharyngeal plexus neurectomy, or botulinum toxin injection. At the time of the laryngectomy procedure, the pharyngeal closure is critical to later speech acquisition. There are many methods recommended for the closure, but the most reliable method for speech acquisition is a posterior pharyngeal myotomy. This inhibits reflexive hypertonicity, allows for 3 layer reconstruction of the pharyngeal wall and preservation of some tonicity so that voice instead of whisper results.

As a variant of the pharyngeal reconstruction I have described, Professor Amatsu recently reported in Arcachon, France at the International Congress on Laryngectomy and Swallowing disorders, a modification of his initial technique to improve the tonicity of the tracheal esophageal shunt itself to decrease the problem of aspiration of the saliva into the trachea. This innovative idea uses bilateral slips of the esophageal constrictor muscles based inferiorly and wrapped around the tracheal shunt. During swallowing the shunt is collapsed by the innervated musculature closing the pathway into the trachea and eliminating the possibility of regurgitation. This is a further development in the understanding of the upper esophageal constrictor and its role in the problem of post laryngectomy speech acquisition.
The voice prostheses have evolved into better valve mechanisms and improved retention characteristics. This makes their use easier for patients and clinicians. There are a growing number of devices in the world each with different improvements and enhanced airflows, but comparable voice results. In addition to the voice prostheses, tracheostoma valves were developed to eliminate the need for hand closure of the tracheostoma during speech. These valves are usually of flap design and fit over the stoma with adhesives, or in the stoma on a tracheostomy tube. They have improved the hygiene of tracheoesophageal speech and its convenience. Some of the valves have also incorporated heat and moisture exchangers to diminish the effect of drying of the trachea by ambient air.

In order to be complete, it is important to review additional methods of laryngeal cancer treatment currently used in the United States. During the period of development of the voice prosthesis, “near total laryngectomy” was introduced by Pearson and has gained some advocates. Radiation therapy techniques have been changing toward “hyperfraction” approaches with twice daily treatments designed to reduce the period of recovery of the vulnerable cancer cells.

Encouraging results of this therapy are being reported. An additional treatment method is “organ preservation” which includes the use of chemotherapy and radiation therapy with reported results equivalent to surgery and preservation of the voice (Table 1). Other forms of partial and near total laryngectomies are being reported and generally comprise methods described initially in France as “crico-hyoido-epiglottoplasty.” These are important procedures because unlike the Pearson procedure of near total laryngectomy, they offer the possibility of tracheal decannulation and closing the airway. This is a major step forward unless aspiration becomes a problem.

The method initially described by Amatsu, and the technique of endoscopic voice restoration that I described are important bridges. They permit speech after laryngectomy that is understandable and socially acceptable. They are safe for patients, and do not require time consuming speech therapy, training, or time expense. Importantly, the critical decisions made in the treatment of cancer of the larynx and their impacts on voice have been positively influenced by these two procedures. When patients contemplate the treatment for laryngeal cancer they have a number of

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**Table 1** Scheme for laryngeal preservation by induction chemotherapy and radiation therapy.

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<th>LARYNX PRESERVATION IN HYPOPHARYNGEAL SQUAMOUS CELL CA.</th>
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<td>(J.L. Lebvre et al. ASCO, 1994)</td>
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<td>Surgery → Radiation Therapy</td>
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<td>Responders* (Additional Cycle of Chemotherapy) → Radiation Therapy</td>
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<td>Residual → Surgery</td>
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<td>Induction Chemotherapy (2 Cycles)</td>
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<td>Non-Responders → Surgery → Radiation Therapy</td>
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<td>Induction Chemotherapy: Cisplatin and 5-FU</td>
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options and voicelessness is no longer one of them. Because of the improved options, careful decisions can be made to maximize curability and not jeopardize an individual’s chances of survival because of overconcern about the voice.

The current state of voice restoration after total laryngectomy represents a bridge to the future. Patients and clinicians no longer must anguish over total loss of the human voice and the consequences of this state. Laryngeal cancer can be treated with voice preservation. The future continues to be challenging and it is difficult to see where it will go. There is discussion about laryngeal transplantation and the recent experience of Strohm at the Cleveland Clinic with a post traumatic laryngeal transplant. Critical issues of organ rejection, immunosuppression and consequent malignancy are yet to be resolved, as well as the ethical issues inherent in this approach.

The goals of excellent voice, normal swallowing function, and a normal upper respiratory tract remain for the future. Improving surgical techniques and the expansion of microvascular surgery, may one day allow for a true laryngeal reconstruction that meets these goals. It is the international interplay of ideas, critique, and experience based on friendship that has taken us this far as I have outlined in this brief American and Japanese experience that originated in this city of Kobe. Continued friendship and scientific exchange will continue to take us many places we have not yet even thought of. I express my gratitude to the Japanese Bronchoesophageal Association for their interest in the past and for this current honor to speak to you. I look forward to future meetings, ideas, and friendships.

REFERENCES


