ASSESSMENT OF SWALLOWING IN ADULTS:
QUALITATIVE AND QUANTITATIVE MEASURES

INTRODUCTION

Swallowing is defined as the semiautomatic motor action of the muscles of respiratory and gastrointestinal tract that propels the food from the oral cavity into the stomach (Miller, 1986). This act involves four stages: oral preparatory, oral transport, pharyngeal and esophageal stages; and these four stages must work in an integrated manner for a safe swallow. Swallowing is also a complex phenomenon involving respiration, phonation and swallowing occurring at the same anatomic location, requiring coordination with each other, for a safe swallow and proper exchange of gases (Miller, 1999).

Swallowing problems are often encountered by speech pathologists in their clinical practice. Byles (2005) has reported that in United States alone 15 million individuals suffer from dysphagia every year. Swallowing problems can manifest in the form of drooling, food pocketing, aspiration, undernutrition, etc with one or more underlying pathophysiology. These symptoms increase the risk for aspiration pneumonia, which is often associated with increased mortality rate. Hence, it is important to identify the symptoms of dysphagia at an early stage and intervene without delay in order to prevent the adverse complications. Identification of dysphagia is an organized and goal directed process covering various components of swallowing. The goals of the swallowing assessment include characterizing the abilities and impairments in the swallowing process, determining underlying pathophysiology, and the degree to
which these impairments can be modified (Langemore & Logemann, 1991). Swallowing can be assessed with qualitative as well as quantitative measures.

Qualitative assessment involves the use of a subjective interpretation or observation as a tool in the evaluation of swallowing, aiming at characterizing the nature and extent of the problem. Every aspect in this process is planned to address the issues of nutritional status, swallow safety, diet modifications, suggestions for non oral feeding, and the need for further instrumental assessment. Various assessment protocols are available in the literature for screening as well as comprehensive evaluation, focusing on various aspects of swallowing such as trial swallows or oral sensory assessment and/or oromotor assessment. There exists a need to develop a comprehensive tool for the assessment of swallowing problems incorporating all the required components and hence the present research.

Quantitative assessment involves the use of a measurable objective (instrumental) data to quantify various components of swallowing, thereby, augmenting the clinical swallow examination. Videofluoroscopy and Fiberoptic endoscopic evaluation of swallowing (FEES) are the most popular methods in the assessment of swallowing disorders. Though these procedures provide useful information regarding the physiology of swallow, they are invasive and involve some exposure to radiation. Moreover, these invasive procedures do not provide complete information on neuromuscular abnormalities in the oropharyngeal and laryngeal structures. To overcome these limitations, non invasive procedures are adopted for the measurement of swallowing, which provide graphical display related to temporal and amplitude measures of swallowing. These non invasive measures like surface EMG, nasal
airflow monitoring and acoustical analysis of swallow sounds are the focus of the current investigation.

Surface electromyography (sEMG) gives information about the temporal and amplitude characteristics of muscle contraction during swallowing (Doty & Bosma, 1956; Palmer, 1988; Palmer, Tanaka, & Seibens, 1989; Perlman, Luschei, & Dumond, 1989; Perlman, 1993; Gupta, Reddy, & Cannilang, 1996). As swallowing involves various muscle contractions, and coordination, EMG would be a suitable choice in the evaluation of dysphagia (Schultz, Perlman, & Van Daele, 1994). Various EMG studies which focus on face and neck muscles during swallowing exists, but there seems to be a disagreement among experts regarding the values that correspond to normal and abnormal function (Doty & Bosma, 1956; Palmer, 1988; Palmer, et al., 1989; Perlman, et al., 1989; Perlman, 1993; Gupta et al., 1996; Logemann, 1998). Thus, it is attempted in this study to establish a normative database for swallowing using sEMG in the Indian context.

Nasal air flow monitoring is another measure which gives information about the respiratory swallow coordination. Respiratory swallow coordination is characterized by the cessation of breathing during swallowing, known as swallowing apnea. Swallowing apnea occurs at one of the following four stages in breathing: during inspiration, during expiration, at the transition between inspiration and expiration or between expiration and inspiration (Wilson, Thach, Brouillette, Abu-Osba, 1981; Bamford, Taciak, & Gewolb, 1992). It is established that 75-100% of swallows occur in the expiratory phase in adults (Preiksaitis, Mayrand, Robins, & Diamant; 1992; Shaker, et al., 1992; Paydarfar, Gilbert, Poppel, & Nassab, 1995; Hiss, Treole, &
Stuart, 2001) compared to 39% in newborns (Bamford, et al., 1992). If the respiratory swallow coordination deviates from this pattern, it can be considered ‘abnormal’. But, the functional significance of this deviation is yet to be understood completely. Interpretation of swallowing is challenging owing to the variations in the apnea duration reported in the literature (Preiksaitis, et al., 1992; Shaker, et al., 1992; Paydarfar, et al., 1995; Hiss, et al., 2001). Hence, there is a need for investigating these aspects systematically, keeping age, gender, bolus consistency, and bolus volume in focus.

Cervical auscultation measure provides information about the characteristics of swallow sounds. It involves placing the microphone on the external surface of the neck and analyzing the swallow sound, providing information on the amplitude and temporal characteristics of the swallow sounds. Studies have indicated that the swallow sounds detected using cervical auscultation can distinguish between individuals with and without dysphagia (Bosma, 1976), with spectral, temporal and amplitude components of swallowing sounds (Logan, Kavanagh, & Wornall, 1967; Hamlet, Nelson, & Patterson, 1990; Zenner, Losinski, & Mills, 1995, Youmans & Steirwalt, 2005). However, there appears to be no consistent pattern available for the acoustic event related to swallowing across age, gender, bolus consistency and volume. Hence there is a need to examine the acoustic aspects of swallowing with respect to these factors especially in the Indian population.

**Need for the study:**

Several methodological issues related to the normal swallowing need to be addressed. The first of these issues is the use of qualitative measures. Various swallowing
assessment tools exist in the literature. But these is no consistency in the parameters involved like some of them incorporate trial swallows, some include oral sensory assessment and some restrict only to oromotor assessment. These observations highlight the need for a comprehensive tool which incorporates all the necessary information needed for treatment recommendations.

The second of these issues is chronological age, and gender. Majority of the past investigations have not examined the influence of age across the life span on the swallowing event. Also, the influence of gender on swallowing revealed ambiguous findings.

Third of the issues is the bolus consistency and volume. Bolus consistencies and volume have been reported to influence the swallowing physiology. However, studies done so far have considered various types of bolus consistencies and volume which cannot be generalized to the Indian population. Hence, there is a need for systematically exploring these aspects in the Indian population.

Finally, the variation in the anatomical structure between the Western and Indian population demands the development of norms in the Indian context. To the best of our knowledge, there is no study which has focused on the aspects of swallowing in the Indian context. Hence, the present study has attempted to measure swallowing pattern across the age, gender, bolus type and volume using qualitative and quantitative measures.
**Aim of the study:**

To profile the swallowing behavior in adults and geriatrics using qualitative and quantitative measures

**Objectives of the study:**

- To develop a qualitative measure for the assessment of swallowing in adults and geriatric population.
- To study the EMG for the assessment of swallowing in adults and geriatric population, for different bolus type and volume.
- To study the nasal airflow monitoring measures for the assessment of swallowing in adults and geriatric population, for different bolus type and volume.
- To study the cervical auscultation measure for the assessment of swallowing in adults and geriatric population, for different bolus type and volume.