

**Charting the recovery of dysphagia in two complex cases of post-thermal burn injury: Physiological characteristics and functional outcomes**

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## **Abstract**

**Purpose:** The current study examined the physiological deficits, recovery pattern and outcomes observed clinically and instrumentally in two participants with dysphagia post thermal burn.

**Methods:** Participants were followed prospectively using clinical and instrumental tools of assessment until dysphagia recovery. Clinical swallowing examinations were carried out every 1 to 2 days, or as clinically indicated. Instrumental assessment using fiberoptic endoscopic examination of swallowing was carried out at fortnightly intervals.

**Results:** Despite variability in the achievement of oral intake milestones, both cases demonstrated protracted recovery from dysphagia contributed to by medical instability and lengthy periods of ventilation and intubation. Instrumental assessment confirmed silent aspiration in both participants, likely due to decreased laryngopharyngeal sensation. By discharge, participants had returned to their pre-morbid diets.

**Conclusions:** This study highlights the protracted and complex recovery pattern associated with dysphagia following thermal burn injury. The presence of silent aspiration emphasizes the need for instrumental assessment to objectively assess aspiration risk and to facilitate dysphagia recovery within this population.

**Key Words** Dysphagia; burn injury; outcome; resolution; oral intake; fiberoptic endoscopic evaluation of swallowing; silent aspiration

## **Introduction**

Although not traditionally recognised as a key member of the multidisciplinary burn care team, there is growing recognition of the role speech-language pathologists (SLP) have in the assessment and management of dysphagia following burn injury. Recent research has reported that up to 18 % of adult patients admitted to hospital with thermal injury present with dysphagia (DuBose et al., 2006; Rumbach et al., 2011a; Rumbach et al., 2014). Dysphagia in this clinical population is recognised to be multifactorial, resulting from a combination of the severity of the burn injury and its medical management (Rumbach et al., 2011a). A study of 49 individuals with dysphagia post thermal burn conducted by members of this research group found those with mild dysphagia (28%) presented with oral stage deficits, whilst individuals rated as having moderate (31%) or severe (41%) dysphagia presented with deficits in both oral and pharyngeal phases of the swallow (Rumbach et al., 2012a). Further investigation of part of this cohort (n = 13) found common clinical signs of dysphagia to include a weak or absent voluntary cough (77%), dysphonia (100%), poor dentition (54%) and decreased lip and jaw strength and range of motion (100% and 54% respectively). These difficulties, coupled with scarring and contracture formation, resulted in inadequate labial closure, increased oral preparation and bolus formation time and diffuse oral residue (Rumbach et al., 2012a).

Whilst numerous studies have highlighted deficits in the oral stage of the swallow post burn (Clayton & Kennedy, 2007; Clayton et al., 2009; Rumbach et al., 2009; Rumbach et al., 2011b; Wust, 2006) few have described pharyngeal phase problems and the nature of their recovery. Muehlberger et al. (1998) were the first to document swallow

function post burn using modified barium swallow in patients with inhalation injury yet the details regarding the physiological characteristics of the disordered swallow were sparse. Videofluoroscopic assessments conducted on 11 patients with dysphagic symptoms, revealed only four patients with mild dysphagia, characterised by mild pharyngeal pooling and delayed swallow reflexes. Edelman and colleagues (2008) also reported retrospective data for 11 patients post burn. Again there was a lack of information provided regarding the nature of the swallow, other than noting ten had dysphagia, described as oral (n = 1), pharyngeal (n = 1), oropharyngeal (n = 6) and pharyngeal/oesophageal (n = 2). Pharyngeal dysphagia was reported as being predominantly a result of burn scar formation and inhalation injury (Edelman et al., 2008).

To date there has been only one prospective cohort study which has reported on the physiological characteristics of the swallow. Rumbach and colleagues (2012b) reported on 13 patients with dysphagia after thermal burn injury using fiberoptic endoscopic evaluation of swallowing (FEES) conducted at an average of one month (range = 5-80 days) post injury. FEES assessment confirmed numerous pharyngeal phase deficits, with impaired secretion management, laryngotracheal oedema, delayed swallow initiation, impaired sensation, inadequate movement of hypopharyngeal and laryngeal structures, and the presence of diffuse pharyngeal residue being evident in greater than 50% of the cohort (Rumbach et al., 2012b). Penetration and aspiration was also found to be prevalent (83% of thin fluid trials), with penetration/aspiration being silent in 50% of cases (Rumbach et al., 2012b).

Whilst the literature to date has provided some insight into the nature of the deficits which may present, there is currently little understanding into the patterns of

recovery in this population. A cohort study that used clinical swallow assessments to chart the pattern of dysphagia recovery in 49 patients revealed that the pattern of recovery was variable and protracted over months (Rumbach et al., 2012a). Case studies of dysphagia recovery in complex burns cases (Clayton & Kennedy, 2007; Clayton et al., 2009; Clayton et al., 2010; Rumbach et al., 2009a; Rumbach et al., 2011b), have also shown that deficits in oromotor control, pharyngeal and laryngeal function contribute to the presence of a severe and protracted dysphagia. In most of these studies though, clinical swallow assessments have been the sole tool used to map recovery. In the few studies that have included data from instrumental assessments (Edelman et al., 2008; Muehlberger et al., 1998; Rumbach et al., 2009a; Rumbach et al., 2011b; Rumbach et al., 2012b), results have been reported as part of the initial case presentation and only then repeated occasionally during the course of recovery. To date, no studies have systematically documented the pattern of swallow recovery with a combination of clinical and instrumental swallowing assessment.

Our understanding of the nature of the swallowing impairment and its course of recovery in the adult burns patients is still in its relative infancy. The current study details the course of recovery for two participants with dysphagia following thermal burn injury using both clinical (clinical swallowing examination, CSE) and instrumental means (FEES). These cases provide insight into the nature of dysphagia, its course, and complicating issues for dysphagia management that have the potential to inform SLP services.

## **Method**

### **Participants**

Two participants (1 male, 1 female) who presented for management at a specialised burn care centre in Brisbane, Australia were included in this study. Participants had to present with a thermal burn injury (i.e., injury caused by exposure to extremes in temperature), with or without concomitant inhalation injury (i.e., “injury to the epithelial lining of the lower tracheobronchial tree and the lower airway” [Muehlberger et al., 1998, p. 1003]), as confirmed in medical records by a medical officer, and be diagnosed with dysphagia by a SLP following an initial clinical assessment. Participants were excluded from the study if (1) they did not receive a thermal burn, (2) they were admitted for palliative management only, (3) they did not undergo FEES examination at multiple time points during their acute hospital admission, and/or (4) they had a prior history of a swallowing disorder or an existing neurological or structural impairment that could influence swallowing behaviour. During the recruitment period of 24 months (July 2007-August 2009), 438 acute burn admissions were screened for dysphagia, 49 of whom obtained a formal diagnosis of swallowing impairment. Although instrumental assessment of swallowing function was desired to confirm dysphagia presence and severity of impairment in all cases, limited equipment and staffing precluded the routine use of FEES. Of the 49 patients whom were clinically determined to have dysphagia, 19 patients underwent FEES (Rumbach et al., 2012b), with only two meeting the criteria of having repeat FEES.

### **Ethical considerations**

Ethical approval for the study was obtained from the relevant hospital and university ethics committees.

### **Procedure**

Initial dysphagia assessment for participants took place once medical stability to commence oral intake was achieved. Medical stability was determined by the medical officer and defined as the point at which the patient was determined to have a stable respiratory system, the ability to tolerate an upright position for at least 10 minutes, and to maintain a sufficient level of alertness to tolerate swallowing evaluation. Following patient consent and the achievement of medical stability, participants were prospectively followed using clinical and instrumental tools of assessment. CSEs were carried out every 1 to 2 days, or as clinically indicated, until clinical resolution of dysphagia. Following initial diagnosis of dysphagia and commencement of some oral intake, FEES was initiated based on clinical need and availability (as per hospital practice) and then at 2-week intervals until resolution. Both the CSE and FEES were carried out as per the protocol outlined in Rumbach et al. (2012b). It is important to note that independent use of FEES by SLPs is not authorised in this facility. This is common practice across the majority of tertiary and quaternary hospitals in Australia. An otorhinolaryngologist (ENT) or a medical practitioner competent to perform endoscopy is responsible for passing the nasendoscope. Despite there often being multiple clinical indications to conduct FEES, access to and availability of FEES is limited due to the need for ENT involvement and the equipment required.

Medical parameters regarding the burn injury and its treatment from admission to discharge were recorded for each patient, including durations for; inpatient stay,



ventilation, endotracheal tube (ETT) intubation, and tracheostomy, if applicable.

Furthermore, key swallowing-related time points were also recorded based on the CSEs conducted over the course of recovery for each participant. These included days to first swallow assessment (DFSA), days to initiation of oral feeding (DIOF; the stage at which fluid and/or food [+/- modifications to consistency and texture] could be safely managed), days to total oral feeding (DIOF; i.e., without supplementary feeding), days between DIOF and DIOF, and days until return to normal oral intake (DRNI).

## **Case Studies**

### **Participant 1**

An 18-year-old female admitted with 22% total body surface area (TBSA) scald burns to the neck, anterior and posterior trunk, bilateral upper limbs and the left leg (see table 1 for demographics). She had a premorbid history of epilepsy and mild intellectual disability. There was no pre-morbid history of dysphagia. The participant was from a culturally and linguistically diverse (CALD) population with English as her second language, which complicated the assessment process despite use of interpreter services. During a 23-day stay in the Intensive Care Unit (ICU), she underwent three surgical procedures and was intubated and ventilated for two separate periods. Alternative feeding via a nasogastric tube (NGT) was initiated upon hospital admission. The patient was first extubated on Day 2 post injury, with referral to SLP being initiated on Day 4, marking DFSA (see table 2; see figure 1).

*/Insert tables 1 and 2 near here/*

At the time of referral, the patient was nil by mouth (NBM) with a NGT in situ. She was drowsy on presentation with nursing staff reporting periods of agitation requiring restraint. She had been frequently requesting water. Trials of water provided by nursing staff suggested aspiration risk due to coughing. She was also febrile and had a moist cough with decreased breath sounds bibasally, indicating poor chest health. Following discussions with the medical team, a CSE was cautiously conducted. On CSE, she was unable to consistently follow commands due to English being her second language and the assessment being conducted in the absence of an interpreter. CSE revealed she had poor dentition (both missing teeth and teeth with advanced decay) and had a weak, but normal vocal quality. Due to inability to comprehensively assess oromotor function, and the patient's medical state, a trial of extremely thick fluids was conducted. Trials revealed suspected delayed swallow initiation though there was nil clinical evidence of laryngeal penetration and/or aspiration. Initial oral feeding commenced with caution after consultation with the medical team in regards to risk. Close monitoring of oral feeding with small amounts of extremely thick fluids proceeded. Oral feeding was then ceased on day 8 due to a decline in participant 1's medical condition; left lung collapse confirmed by bronchoscopy which necessitated re-intubation and mechanical ventilation.

Participant 1 was successfully extubated on day 21 with involvement of SLP requested again on day 24 post-burn. CSE revealed good lip and tongue oromotor function. However, the patient now presented with aphonia and was unable to produce an

adequate cough. She also presented with audible upper airway breath sounds, suggesting poor ability to handle secretions. Swallow trials of extremely thick fluids revealed an ineffective swallow, with multiple swallows required to clear a bolus through the pharynx, and as such, she was considered at high risk of aspiration secondary to suspected pooling in the pharynx and remained NBM. The patient was then scheduled for a FEES assessment in the next available clinic (Day 29). Ongoing patient monitoring and repeat assessment on Day 26 revealed some improvements in swallow function via CSE; with prompt swallow initiation and only one swallow required per bolus. Fatigue limited any further trials. Participant 1 was commenced on a diet of extremely thick fluids under nursing staff and SLP supervision, with instruction that all oral intake was to cease if any clinical signs of penetration/aspiration were observed.

FEES assessment conducted on Day 29 revealed slight oedema of the arytenoids and interarytenoid region, small areas of granuloma on the left vocal fold, decreased left vocal cord movement, and mild supraglottic construction. However, according to the ENT, this did not account for the extent of the participant's aphonia. All other structures had normal strength, range, symmetry and speed of movement. Trials of thickened fluids under FEES revealed no evidence of penetration or aspiration. Thin liquid trials revealed an adequate oral phase with reasonable oral containment. However, bolus driving and clearing forces were impaired, with the patient using three to four spontaneous clearing swallows after the initial swallow. These clearing swallows were not efficient and residue along the pharyngeal walls and in the valleculae, lateral channels and pyriforms remained.

Aspiration of thin fluids after the swallow was observed, with an inconsistent cough being elicited, which was ineffective in clearing material from below the vocal folds. Residue at the petiole of the epiglottis, true and false vocal folds and subglottic shelf were noted post swallow. Reduced sensation denoted by the absence of the laryngeal adductor reflex (i.e., brief closure of the true vocal cords with a light touch of the scope to the arytenoid epithelium) was noted. There was variable response (nil to slight cough) to aspiration events. Trials of food textures revealed difficulties with mastication, fatigue issues and diffuse pharyngeal residue. A diet of mildly thick fluids and pureed foods was recommended. Nil additional compensatory or rehabilitation strategies were trialed due to the patient's inability to follow and remember instructions provided in the absence of an interpreter.

Ongoing difficulty with mastication of foods and multiple swallows required to clear a bolus of minced and moist consistency was observed on CSE at day 32, resulting in the continuation of a mildly thick and smooth pureed diet. The NGT was self-removed on Day 33, and following team consent was not re-inserted. Thus, DTOF was 33 days and DI-TOF was 29 days (see table 2). Clinical re-assessment 2 days later revealed improvement in mastication for foods and Participant 1 was upgraded to a soft diet, consistent with her pre-morbid diet. It was noted that the patient and family were non-compliant with fluid recommendations once a pre-morbid diet recommenced. Thin fluid trials with SLP revealed ongoing issues with delayed swallow initiation and multiple swallows required to clear a bolus. This information, coupled with her known history of silent aspiration on thin fluids, led to her remaining on mildly thickened fluids.

Additional education regarding the need for modified fluid consistency was provided to the patient and her family.

Ongoing clinical review revealed small improvements (i.e., decreased fatigue, increased levels of alertness) though there was concern regarding ongoing risk for aspiration on thin fluids due to previous detection of silent aspiration. Repeat FEES assessment on day 43 with thin fluids revealed a 2-5 second delay in delivery of the bolus to the pharynx with occasional spill to the pyriforms during the oral phase. A small amount of residue was observed in the left pyriform, valleculae, lateral channels and posterior cricoid region, implying persisting weakness in base of tongue (BOT) and pharyngeal longitudinal and constrictor movement. There was nil evidence of penetration or aspiration on thin fluid. Sensation appeared improved, with a gag elicited in response to the scope touching the BOT, and the laryngeal adductor reflex present on touch of scope to the arytenoid epithelium. The participant remained aphonic, with decreased vocal cord movement on the left and incomplete glottic closure. She was subsequently considered safe to commence a diet of thin fluids and soft foods, indicating DRNI was 43 days. Hospital discharge followed on Day 44, where ongoing monitoring of the patient's persisting aphonia by SLP and ENT was recommended.

*/insert Figure 1 near here/*

## **Participant 2**

A 43-year-old male was admitted with 51% TBSA self-immolation flame burns to the trunk, bilateral lower limbs, perineum and right arm. Inhalation injury was suspected and, upon admission, he was intubated, and ventilated with feeding via NGT commenced

(see table 1). During a 41-day stay in ICU, the participant underwent 14 surgical procedures (debridement/skin grafts). Due to a prolonged period of difficult weaning, extubation and a surgical tracheostomy were performed to maintain the airway on Day 24. Tracheostomy insertion was delayed to allow healing of cutaneous injury on the anterior neck. Successful weaning from ventilation and transfer to the burns unit was achieved on Day 41 (see figure 2).

The patient was referred to SLP on Day 45 but was deemed unsuitable for assessment until Day 47 (i.e., DFSA) due to persisting tachycardia and pain. At the time of the initial CSE, the participant had a tracheostomy and NGT in-situ and ongoing generalised fatigue. Oropharyngeal examination revealed impaired range of movement of lips, and a weak, dysphonic vocal quality. Swallow trials of extremely thick fluids during cuff deflation (with speaking valve in situ) revealed good oral control. Initial suction post swallow trial showed no evidence of aspiration. However, suctioning conducted one hour later revealed small amounts of coloured fluids, suggesting delayed aspiration secondary to pooling of fluids. The patient was placed NBM.

CSEs on subsequent days (Days 48-50) revealed improving voice quality, and by Day 51 the patient was placed onto a diet of extremely thick fluids and pureed desserts (DIOF at 51 days, see table 2). CSE on Day 52 revealed further improvement resulting in an upgrade to mildly thick fluids and a pureed diet. Decannulation occurred on Day 53. CSE on the next day indicated functional ability to manage general foods with adequate mastication and nil evidence of oral residue, however wet phonation was still persistent after thin fluid trials. He was upgraded to a general diet, with mildly thick fluids. FEES assessment was carried out on Day 65. Anatomic and physiologic assessment of swallow

structures revealed normal laryngeal anatomy but a reduced response to pharyngeal secretions, with pooling occurring particularly in the right pyriform and around the participant's NGT. Trials on thickened fluids revealed diffuse residue through the hypopharynx which was cleared by 1-2 spontaneous clearing swallows. Trials of thin fluids revealed a moderate amount of residue, with up to 50% of the bolus pooling in the valleculae, lateral channels, pyriforms and undersurface of the epiglottis during single sips of thin fluid, which led to penetration after the swallow and no responsive cough. Trials with continuous sequential sips of thin fluids revealed silent aspiration. The patient was impulsive with drinking despite prompts from SLP to control rate of oral intake. Therefore, nil additional compensatory (i.e., postural) strategies were trialled to reduce or eliminate penetration/aspiration as non-compliance with prescribed techniques was likely. The patient remained on mildly thick fluids and general foods.

Removal of the NGT occurred on Day 69 (D<sub>TOF</sub> at 69 days; DI-TOF 18 days; see table 2). CSE on Day 75 revealed no change in swallow function. A repeat FEES assessment was carried out 2 weeks after the initial FEES (day 79). Status of secretions in the hypopharynx appeared improved, with minimal secretions pooling in the pyriform fossae and valleculae. Nil evidence of penetration or aspiration for single sips and continuous drinking of thin fluids were noted by the conclusion of bolus trials and he was upgraded to thin fluids and general foods, indicating DRNI was 79 days. A final CSE on Day 80 confirmed nil difficulty with the general diet and thin fluids and he was subsequently discharged from the SLP service on Day 83. Discharge from the hospital occurred on Day 93.

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## Discussion

It is well documented that course and recovery of dysphagia in the burn population is both variable and often protracted (DuBose et al., 2005; Edelman et al., 2008; Rumbach et al., 2011b; Rumbach et al., 2012a; Rumbach et al., 2009a; Ward et al., 2001) and the considerable variability in progression towards oral intake seen in these two cases is consistent with this pattern. Both participants experienced prolonged periods of medical instability arising from the pathophysiology of burns and personal factors which contributed to the delayed commencement of oral intake (DIOF) and speech-language pathology management. Increased level of dysphagia disability and subsequent delayed DIOF have been reported to be influenced by factors including severity of burn injury, presence of inhalation injury, lengthy periods of ventilation, ETT intubation and medical instability (DuBose et al., 2005; Rumbach et al., 2011b; Rumbach et al., 2012a; Ward et al., 2001). A positive linear relationship between number of days on the ventilator and tracheostomy and DIOF has also been reported in the burns literature (Clayton et al., 2010; DuBose et al., 2005). Furthermore, literature in other critical care populations have found prolonged ventilation to contribute to dysphagia due to induced periods of inactivity of swallowing muscles and potential glottic injury from intubation, precipitating swallowing dysfunction (Morgan & Mackay, 1999). Therefore, Participant 2's severe burn injury, inhalation injury, lengthy ventilation (41 days), ETT intubation (24 days) and tracheostomy duration (29 days) potentially contributed to his dysphagia impairment and protracted DIOF. Although Participant 1 had a shorter DIOF (potentially due to her less severe injury and shorter period of intubation and ventilation in



comparison to Participant 2), the need for a second 13-day period of intubation and ventilation meant all oral intake was ceased.

Dysphagia management was prolonged for both participants, lasting 40 days for Participant 1 and 38 days for Participant 2. This finding was comparable to published reports of dysphagia management, with previous cohort studies reporting average duration of SLP intervention lasting 29 to 43 days (Rumbach et al., 2012a; Ward et al., 2001). While ventilation and surgical procedures contribute initially to the protracted recovery, additional medical issues associated with the burn population can be expected to compound this. Common sequelae of burn injury including infection, sepsis, cardiovascular insufficiency and contracture formation can contribute to medical instability (Herndon, 2012). Participant 1 displayed fluctuations in medical stability due to the need for a second intubation from lower left lung collapse. Participant 2 also demonstrated fluctuating medical state due to persistence of tachycardia (i.e., increased heart rate), which commonly occurs in severe burns due to fluid loss (Herndon, 2012). Thus, in both cases, medical conditions arising from the pathophysiology of burns and the resultant treatment caused further medical instability which complicated and delayed dysphagia recovery.

The current two cases highlight the importance of using a combination of clinical and instrumental techniques to assess and monitor dysphagia after thermal burn injury. Through the combination of both forms of assessment in this study, it was possible to closely monitor impacting factors (e.g., fatigue) as well as oral and pharyngeal phase deficits contributing to aspiration risk. Although neither participant in the current study presented with facial burns, or oral stage impairments relating to contracture formation,

mastication of solids was laboured for Participant 1 due to the poor dentition and fatigue, which subsequently delayed oral intake milestones (Esfahlan et al., 2010). Both participants also experienced issues with fatigue and daily changes to functional ability which were best monitored through a clinical swallow assessment. As videofluoroscopy is generally unsuitable for use in the acute burns population (i.e., before complete burn wound closure and maturation of scarring; Rumbach et al., 2009b), the CSE played a valuable part in the overall assessment of oral motor status and functioning.

FEES assessment was critical for the accurate detection of aspiration risk. Decreased laryngopharyngeal sensation was identified in the initial FEES assessment of both participants. Reduced pharyngeal and laryngeal sensation has been found to be a common feature in the thermal burns population with prior research reporting that 77% of cases in a cohort study had minimal or no response to contact of the scope to the hypopharyngeal structures during FEES (Rumbach et al., 2012b). Silent aspiration, as evidenced by the cases presented here, may be a possible outcome (Rumbach et al., 2009b; Rumbach et al., 2012b). The ability to use repeated FEES assessments to follow changes to swallowing physiology over the recovery period revealed that these sensory deficits improved greatly over the two-week period between the initial and repeat FEES in both cases. The presence of an ETT or tracheostomy tube has been shown to alter the mechanoreceptors and chemoreceptors of the pharyngeal and laryngeal mucosae, causing dysfunction of the swallowing reflex (de Larminat et al., 1995). Furthermore, it has previously been postulated that concomitant inhalation injury, resulting in sloughing of and damage to the mucosa may precipitate decreased sensation (Cohen & Guzzardi, 1983; Gaissert et al., 1993). The underlying mechanisms contributing to recovery of

pharyngeal and laryngeal sensitivity may be accounted for by (1) the healing of burn-affected tissues, as well as (2) the withdrawal of medical treatments (e.g., removal of ETT/tracheostomy, weaning of sedation, removal of NGT to allow normalisation of function of chemo- and/or mechanoreceptors located in the pharyngeal and laryngeal mucosae).

It is important to note that the assessment and management processes used in these cases are representative of the current clinical practice and are not intended to represent a gold-standard. Although utilisation of FEES for initial assessment in this complex patient population is desired, service constraints may not permit regular scoping at initial assessment and/or at regular intervals. In Australia, the majority of SLPs are unable to perform FEES independently; an ENT is required to pass the endoscope and thus FEES availability is limited. Having greater access to FEES, at the time the clinical need is identified, may have allowed more expeditious return to normal oral intake in these cases; lack of objective FEES data where silent aspiration had previously been confirmed resulted in diet progression towards normal oral intake being potentially delayed. A previous study of dysphagia post thermal burn injury observed that a level of disagreement between CSE and FEES findings existed, with CSE results failing to accurately discern the true severity of the dysphagia in all cases (Rumbach et al., 2012b). Therefore, due to the increased likelihood of silent aspiration in this clinical population, and the inability to detect its presence or its resolution using CSE alone, instrumental assessment is a key component of the assessment process in this clinical population and, if possible, should be utilised routinely when assessing swallow function in the burn population. When FEES is not readily available, it is suggested that SLPs, after

discussions with members of the multidisciplinary burn care team, cautiously initiate oral intake based on all available evidence and that regular and ongoing patient monitoring is available.

Active rehabilitation efforts were not reported in the current study as the participants did not participate in intensive rehabilitation due to compliance and personal participant factors (e.g., Participant 1 = culturally and linguistically diverse; Participant 2 = impulsivity, depression). Clinical experience and limited case reports afford the notion that active rehabilitation of dysphagia is particularly difficult in this clinical population due to high pain levels and protracted medical instability (Rumbach et al., 2009a; Rumbach et al., 2009b; Rumbach et al., 2011b). Furthermore, the coexistence of anxiety and depression with a medical condition complicates the process of intervention (e.g., Participant 2). These complications include noncompliance to diet modifications and nonadherence to rehabilitation program (DiMatteo et al., 2000). Consequently, as evidenced in the current two cases, recovery is often reliant on the use of compensatory techniques (i.e., diet modification) only, coupled with close and frequent monitoring via both CSE and FEES, to enable oral intake to occur with minimal aspiration risk during the recovery period. Information on active rehabilitation techniques and their possible effect for assisting dysphagia recovery following thermal burn injury have not been reported extensively to date. However single case studies have shown the benefits of purpose-built rehabilitation programs in cases of severe dysphagia post burn (Clayton & Kennedy, 2007; Rumbach et al., 2009a; Rumbach et al., 2011b) suggesting active rehabilitation should be implemented whenever possible.

## **Conclusion**

This study contributes to the limited literature reporting on physiological characteristics of the swallow and recovery of dysphagia in burn patients using instrumental assessment. Patients present with multifactorial issues impacting on swallow function, and as such, both clinical and instrumental assessments are needed to provide a holistic assessment of the patients' abilities to manage oral intake, as well as the risk of silent aspiration. While the current study followed clinical recovery of two complex patients assisted by compensatory management only, there remains the need for large scale investigation to determine feasibility and the potential benefit of implementing active rehabilitation to reduce the duration of functional swallowing recovery.

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## **Declaration of interest**

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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Table 1

*Biographical details of the 2 participants*

Biographical variable	Participant 1	Participant 2
Age	18	43
Gender	Female	Male
Cause of burn injury	Scald	Flame
% TBSA burned	22	51
Inhalation burn	No	Suspected
Duration of inpatient stay (days)	44	93
Duration of ICU stay (days)	23	41
Number of surgical procedures (debridement, grafts, contracture releases)	3	14
Days of ventilation	15	41
Duration of ETT intubation (days)	15	24
Duration of tracheostomy (days)	N/A	29
Type of supplementary feeding	NGT	NGT
Duration of supplementary feeding (days)	33	69

*Note.* TBSA = Total Body Surface Area; ICU = Intensive Care Unit; ETT = Endotracheal Tube; NGT = Nasogastric Tube.

Table 2

*Clinical assessment results*

Parameter	Participant 1	Participant 2
Days to first swallow assessment (DFSA)	4	47
Days to initiation of oral feeding (DIOF)	4	51
Days to achievement of total oral feeding (DTOF)	33	69
Days from initiation to total oral feeding (DI-TOF)	29	18
Days to return to normal intake (DRNI)	43 <sup>a</sup>	79

*Note.* <sup>a</sup>Participant 1 returned to soft diet and thin fluids, consistent with her pre-morbid diet.

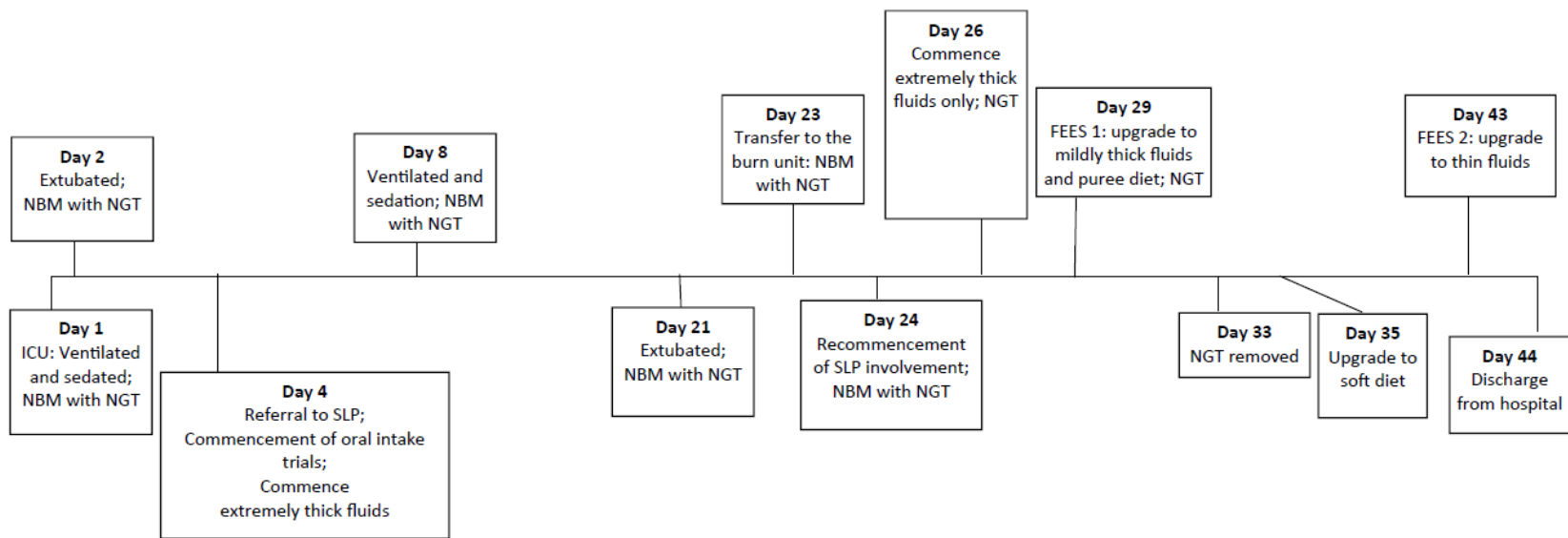


Figure 1

Timeline of speech-language pathology milestones from admission to discharge for Participant 1

Note: FEES = fiberoptic endoscopic evaluation of swallowing; ICU = intensive care unit; NGT = nasogastric tube; NBM = nil by mouth; SLP = speech-language pathology

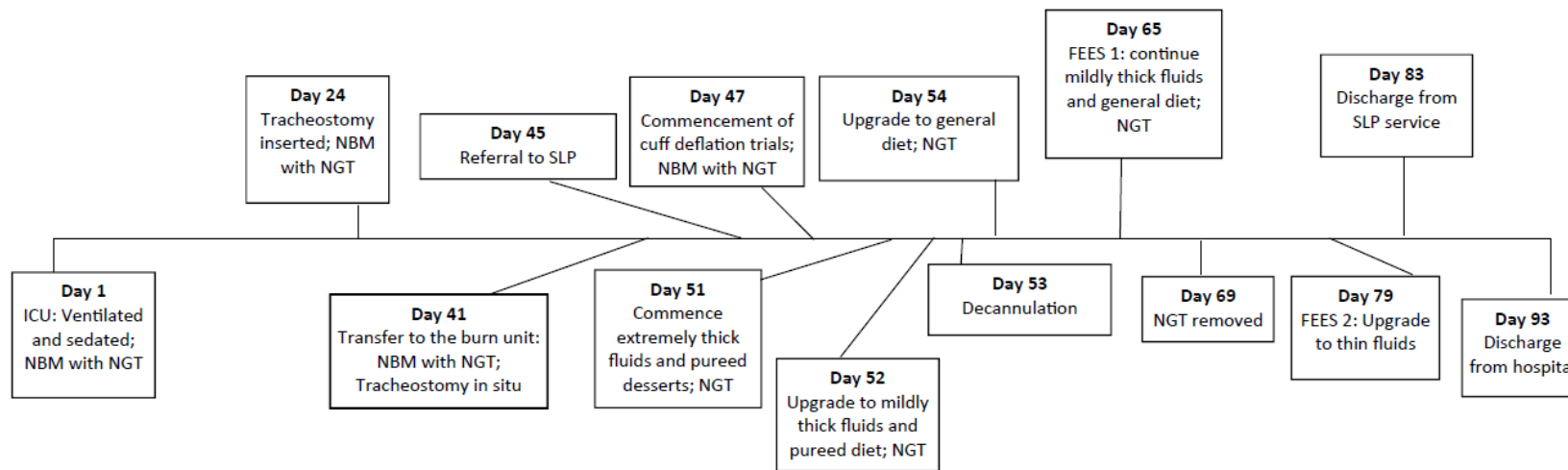


Figure 2

Timeline of speech-language pathology milestones from admission to discharge for Participant 2

Note: FEES = fiberoptic endoscopic evaluation of swallowing; ICU = intensive care unit; NGT = nasogastric tube; NBM = nil by mouth; SLP = speech-language pathology