

Clinical progression and outcome of dysphagia following thermal burn injury: a prospective cohort study

Anna F. Rumbach (BSc, MSpPathSt)¹, Elizabeth C. Ward (BSpThy [Hons], PhD)^{1,2},
Petrea L. Cornwell (BSpPath (Hons), PhD)^{3,4}, Lynell V. Bassett (BSpThy)⁵, & Michael
J. Muller (MBBS MMed Sci FRACS)^{6,7}

¹The University of Queensland, School of Health and Rehabilitation Sciences, Division of Speech Pathology, Brisbane, Australia

²Centre for Functioning and Health Research (CFAHR), Queensland Health, Queensland, Australia

³Metro North Health Service District, Queensland Health, Queensland, Australia

⁴Griffith Health Institute, Behavioural Basis of Health Program, Griffith University, Mt Gravatt, Queensland, Australia

⁵Speech Pathology Department, Royal Brisbane & Women's Hospital, Queensland, Australia

⁶Professor Stuart Pegg Adult Burns Centre, Royal Brisbane & Women's Hospital, Queensland, Australia

⁷Burns, Trauma & Critical Care Research Centre, The University of Queensland, Brisbane, Australia

Corresponding Author:

Anna Rumbach

Division of Speech Pathology,

School of Health and Rehabilitation Sciences,

The University of Queensland, St Lucia,

Brisbane, 4072, Australia.

Ph 61-407 123 879 Fax 61-7-3365 1877, email: a.rumbach@uq.edu.au

This project was supported by funding from the Royal Brisbane and Women's Hospital (RBWH) Foundation.

Clinical progression and outcome of dysphagia following thermal burn injury: a prospective cohort study

Abstract

Objective: (1) To establish clinical profiles of dysphagic and non-dysphagic individuals following thermal burn injury, and (2) To provide a clinical profile of the progression and outcome of dysphagia resolution by hospital discharge for a dysphagic cohort.

Methods: A total of 438 consecutively admitted patients with thermal burns were included. All patients underwent a clinical swallowing examination. Medical parameters regarding burn presentation and its treatment and speech-language pathology specific variables from admission to discharge were collected for each participant. Dysphagia was identified in 49 patients via clinical assessment and their course of recovery was followed until the point of dysphagia resolution, or discharge.

Results: No significant difference was observed between the dysphagic and non-dysphagic groups in age, gender and injury aetiology. However, the dysphagic cohort was significantly different from the non-dysphagic group in all variables pertaining to injury presentation and medical management. Individuals with dysphagia took significantly longer to start, and maintain, oral intake and required non-oral supplementation for three and a half times longer than those who were non-dysphagic. Length of speech-language pathology intervention averaged one month for the dysphagics and increased with dysphagia severity. Return to normal fluid consistencies occurred in over 75% of dysphagic individuals by week 7 post injury, though resumption of normal diet textures was more protracted, with 75% resuming normal oral intake by week 9. Dysphagia has resolved in 50% of the cohort by week 6 and by hospital

discharge, 85% of the dysphagic individuals had resumed normal oral intake of thin fluids and a general diet.

Conclusion: This is the first large prospective cohort study to establish clinical profiles of dysphagic and non-dysphagic cohorts and document the nature of dysphagia and patterns of recovery within the thermal burn population. This current data will assist the allocation and planning of speech-language pathology services and provide baseline data on the course of dysphagia resolution in the adult thermal burn population.

Key Words Dysphagia, burn injury, outcome, resolution, oral intake

Introduction

Dysphagia (swallowing impairment) has long been recognised as a potential negative consequence of thermal burn injury¹⁻⁸, yet to date there has been minimal investigation into the nature and recovery patterns of dysphagia in the thermal burn population. Single case reports^{7,9,10} and retrospective cohort studies within the literature to date¹¹⁻¹³ highlight that the rehabilitation of dysphagia and return to oral intake in this population can be variable, with long term swallowing dysfunction a possible outcome for a small percentage. However, the current absence of prospective, large cohort studies means that the natural history relating to the nature and resolution of dysphagia following burn injury is currently not well understood. In addition, the literature available on patterns of recovery has largely focussed on subsets of patients, such as only those referred to speech-language pathology¹¹⁻¹³ (SLP) or only those with severe burns^{7,9,10}, and hence does not encompass the whole of this clinical population. As such, the nature, severity and course of recovery of the swallowing impairment post thermal burn has yet to be systematically reported.

In the absence of relevant evidence, speech-language pathologists (SLPs) working in burn care settings have had limited data regarding expected patterns of resolution and achievable outcomes or rates of recovery for dysphagia in this population. Such data is necessary to guide assessment and treatment planning as well as facilitate evidence-based prognostic insight. It is important for clinicians, as well as patients and their families to receive accurate information and advice regarding prognosis and the natural history of their swallowing deficit in order to assist in the goal setting process¹⁴.

Thus the present study aims to remedy the current knowledge deficit regarding the natural history of dysphagia following thermal burn injury by (1) establishing the clinical profiles of both dysphagic and non-dysphagic individuals following thermal burn injury through a prospective cohort study of admission and initial treatment characteristics; and, (2) providing a clinical profile of the progression and outcome of dysphagia resolution by hospital discharge. This baseline data will assist clinicians with the prioritization of patient treatment, and aid realistic goal setting for dysphagia treatment that maximises patient rehabilitation. It will also establish an early evidence base for the natural history of dysphagia in this population and may inform future development of clinical management pathways.

Methods

Participant Population

Participants included 438 adults (348 males, 90 females) ranging in age from 13 to 90 years ($M = 38.32$, $SD = 17.40$) with thermal burn injury (i.e., caused by exposure to extreme temperature – hot or cold), with or without inhalation injury, who presented for management at a state-wide, tertiary centre for adult burn care in Brisbane, Australia, over a 24 month period (August 2007 – July 2009). The mean total body surface area (TBSA) affected was 10.46% ($SD = 11.75$, range = 0.5-67.5). The most affected areas (from greatest to least involved) were the upper limbs, lower limbs, head and neck, and trunk. Participants included had no history of existing neurological or structural impairment that could influence swallowing behaviour or a prior history of swallowing disorders, as determined by medical chart review, multidisciplinary discussion, and

patient report. The biographical details of the entire participant cohort were found to be representative of both Australian and worldwide reported burn patient populations in respect to age and gender distribution, injury aetiology, percent TBSA affected and location of injury¹⁵⁻²². A study of dysphagia incidence and predictors for dysphagia risk has utilised the same participant cohort in a previous report²³ and further participant details can be found there. The current study received ethical clearance from the Royal Brisbane and Women's Hospital and the University of Queensland ethics committees. Permission for participant inclusion was sought from the individual, the participant's next of kin or power of attorney, or the parent(s) or guardian if aged less than 18 years.

Procedure

Medical parameters known regarding the burn presentation and its treatment from admission to discharge were collected for each participant. Parameters collected included gender, injury etiology, and dichotomous variables such as presence of head and neck burns, presence of inhalation injury, need for intensive care unit (ICU) admission, need for intubation, and need for ventilation. Additionally, data was collected related to length of hospital stay, length of ICU stay, length of stay in the burn unit, duration of intubation, duration of ventilation, time to conversion of endotracheal tube (ETT) to tracheostomy, and duration of tracheostomy. SLP specific variables relating to safe oral intake as determined from clinical swallow examination (CSE) were recorded for all individuals. These included Days to Initiation of Oral Feeding from admission (DIOF), Days to Total Oral Feeding (no supplementation) from admission (DIOF), days between DIOF and

DTOF (DI-TOF), number of days to achieve a normal diet post admission, as well as the total supplemental feeding period (days) and total period of SLP intervention (days) between admission and discharge.

For the purposes of the current research only, all eligible participants underwent a CSE. Dysphagia status was evaluated, using CSE alone, by a speech pathologist experienced in managing patients post burn injury. Instrumental assessment of swallow (using either videofluoroscopy or fiberoptic endoscopic evaluation of swallowing) was not used to confirm or refute dysphagia presence in this study. The initial CSE was conducted during the acute phase of recovery, directly following determination of medical stability and suitability for oral intake by the medical officer in charge. Medical stability, for this study, was defined as the patient having a stable respiratory system, ability to tolerate an upright position for at least 10 minutes, and the ability to maintain a sufficient level of alertness to tolerate swallowing evaluation. The initial CSE took approximately 20 minutes to complete and consisted of a patient interview, general observation, a perceptual evaluation of vocal quality, an oral motor examination encompassing both visual examination of the oromusculature and cranial nerve examination, observation of ability to handle secretions, performance on dry (saliva) swallows and a series of oral intake trials, if deemed appropriate. Considerations for conducting a CSE of swallowing with burned individuals, as outlined by Rumbach et al⁸, were followed, with each assessment requiring some variation depending on patient presentation.

All participants subsequently diagnosed with dysphagia then underwent a CSE conducted by a speech-language pathologist twice weekly (minimum) until the point of

dysphagia resolution, or discharge home or to another facility. Those participants without dysphagia (n = 389) were continued on a high energy and high protein diet and their involvement in the research project was discontinued at this point. For the purpose of large group analysis of dysphagia resolution, only the dysphagia status at the first weekly assessment was used for each individual unless resolution was achieved within the week. It is important to note that treatment was individually prescribed and was consistent with what are considered traditional dysphagia management and rehabilitation techniques used with the burn population as outlined by Rumbach et al⁸. Frequency of treatment was determined by patient need, as per normal clinical practice at our facility, and no maximum numbers of treatment sessions were prescribed. Each treatment session lasted for approximately 20 to 30 minutes. Individuals who were tracheostomised were able to utilise speaking valves if medically appropriate (airway patency confirmed via respiratory physician or an ENT). Treatment ended when dysphagia resolved or the treatment goals were reached (see information on outcome measures).

Oral motor function was assessed using a cranial nerve assessment prior to oral intake trials. Presence of oedema, and scar and contracture formation at the time of initial CSE was noted. Patient suitability for oral intake trials was determined by information derived from the medical history, and performance data related to oral motor functioning and pharyngeal and laryngeal control. Dietary consistencies trialled were consistent with the Australian standards for texture modified food and fluids²⁴ and included smooth puree, minced and moist, soft and normal food consistencies as well as extremely thick (level 900), moderately thick (level 400), mildly thick (level 150) and thin (regular) fluids. All participants were trialled with the food/fluids considered to be least normal

first (i.e., extremely thick fluids and puree diet), with progression towards normal dietary consistencies and textures (i.e., thin fluids, general diet) if appropriate. Suitability for progression to the next food or fluid texture/consistency was based on (a) the safety of food/fluid intake and (b) the efficiency of food/fluid intake. Safe food and fluid consistencies were determined to be those for which the patient demonstrated no clinical signs of penetration/aspiration or discomfort (i.e., coughing, throat clearing, wet voice, increased respiratory rate, etc) and were able to be managed with efficiency. The efficiency of oral intake was determined by the amount of external facilitation/prompting required and/or the duration and extent of oral motor labour demonstrated by the patient in consuming the various food/fluid presented. This protocol was also consistent for all subsequent CSEs.

Outcome Measures

Three outcome measures related to return to normal oral intake i.e., functional recovery to per-morbid level, were recorded at the initial assessment and for each subsequent re-assessment. These included dysphagia severity and the food and the fluid consistencies safely managed at each assessment. Food and fluid consistencies were defined as per Australian standards²⁴. Dysphagia severity was rated using a purpose-built dysphagia severity rating scale (Table 1). A purpose-built severity scale was required for this study, as existing dysphagia severity scales typically include the need for nutritional supplementation as an indicator of severe dysphagia. As prolonged nutritional supplementation is required for metabolic reasons post burn injury and is independent of the presence of dysphagia, a severity scale that did not incorporate non-oral feeding as part of the severity criteria was required. The scale used in the current study consisted of

three severity levels based on ability to manage various dietary consistencies. This scale and its descriptors are presented in Table 1.

/insert Table 1 near here/

Results

Information relating to admission and treatment characteristics and participants' performance on CSE were entered into a Microsoft Excel program. To establish differences between the dysphagic and non-dysphagic cohorts, the data was coded by the presence of dysphagia and analysed using inferential statistics with Stata software (version 10.0, 2007).

Characteristics of the dysphagic and non-dysphagic patient populations

Statistical comparisons between the dysphagic (n = 49) and non-dysphagic (n = 389) groups was conducted using T-tests and chi-squared tests. A stringent alpha of $p < 0.01$ was adopted due to the multiplicity of tests^{25,26}.

Independent group comparisons on biographical and injury presentation parameters, presented in Table 2, revealed no statistical difference in age ($p = 0.06$), gender ($p = 0.438$), or injury etiology ($p = 0.135$) across the two groups. A statistically significant difference ($p = <0.01$) was found between the two groups with respect to the proportion of patients with head and neck burns and with inhalation injury, which were both higher in the dysphagic cohort (Table 2). Percentage TBSA was also significantly

greater ($p = <0.01$) in the dysphagic cohort, with the average burn size four times greater in those with dysphagia (Table 2)..

/Insert Table 2 near here/

All parameters relating to length of stay and treatment periods are presented in Table 3. A significant difference was found between the two groups for duration of ETT intubation and the period of ventilator support required, with the dysphagic cohort requiring intubation and ventilation for 5-6 times longer than members in the non-dysphagic group. Of those with dysphagia, tracheostomy insertion was performed on 8 participants to support ongoing medical management in individuals slow to wean or who had sustained injuries that necessitated facial reconstruction or repair at an average of 16 days post ETT insertion. Tracheotomy procedure was 50% surgical and 50% percutaneous, with no complications post procedure arising for any of the participants. Decannulation occurred on average 48 days ($SD = 34.74$, range = 7-101) after tracheostomy insertion. Of these 8 participants, all were dysphagic pre and post decannulation. The mean number of days for each hospitalization period (ICU and Burn Unit) and total duration of inpatient treatment was significantly higher for those who presented with dysphagia (Table 3). Individuals within the dysphagic cohort required on average a stay in ICU approximately 12 days longer than the non-dysphagic group, and stayed over 30 days longer in the burn unit. Overall length of hospital stay was almost 5 times higher for the dysphagic group when compared to the non-dysphagics.

/insert Table 3 near here/

Across all parameters relating to referral, assessment and commencing oral intake, the dysphagic cohort took significantly longer to achieve each milestone than the non-dysphagics (Table 4). Specifically, initial dysphagia assessment occurred significantly earlier for non-dysphagic patients at around the second or third day post admission compared to the dysphagic cohort who had their initial assessment on average 2 weeks post admission (Table 4). Further analysis of the dysphagic cohort revealed that initial assessment was initiated within the first two weeks after admission for 63% of all dysphagic subjects, with an additional 24% of subjects being seen initially by SLP in weeks 3 and 4 post admission. The remaining 6 dysphagic subjects were not medically appropriate for initial swallowing assessment until 5 to 8 weeks after injury. On initial assessment all dysphagic subjects were weaned from ventilation but approximately 16% had a tracheostomy in situ and 97% were receiving supplementary feeding via NGT at the time of initial SLP assessment. Following initial assessment not all individuals were appropriate to commence oral intake, therefore average DIOF for the dysphagic population occurred at a mean of 19 days as compared to 1 day for the non-dysphagic population, as those individuals who were non-dysphagic were often placed on a diet at admission, prior to the initial SLP visit (Table 4). Within the dysphagic cohort, 12% (n=6) still had a tracheostomy in situ when they commenced oral intake.

/insert Table 4 near here/

Feeding via orogastric or nasogastric tube (NGT), either for alternative or supplemental means, was employed for 98% (n = 48) of dysphagics and was prolonged over an average period of 34.23 days (Table 4). Only 5% (n=20) of the nondysphagic received supplemental feeding via NGT for an average duration of 9.55 days (Table 4).

Figure 1 indicates the proportion of patients in each group receiving supplementary feeding over time. This shows that over 75% of dysphagic individuals ceased supplementary feeding 7 weeks after hospital admission, with the majority of individuals ceasing supplementation between weeks 2 and 4. Three participants (6%) were discharged receiving ongoing nutrition support via PEG (n = 1) or NGT (n = 2) in conjunction with some oral intake, thus did not reach DTOF. The remaining 46 dysphagic individuals reached DTOF (i.e., without supplementation) approximately 5 weeks after admission (Table 4). Those dysphagics who progressed to maintaining adequate nutritional requirements via oral intake alone during their hospital admission did so on average 14.8 days after initiating oral intake (i.e., DI-TOF) (Table 4). Regarding the duration of overall SLP intervention, the data revealed that non-dysphagic patients in this study typically received a single visit from the SLP upon hospital admission, were placed on a general (high energy, high protein) diet and thin fluids (+/- supplementation as prescribed by the dietician) and received no further SLP intervention. In comparison, the dysphagic cohort on average received a month of SLP intervention, with one patients having up to five months of inpatient management (Table 4).

/insert Figure 1 near here/

Resolution and recovery of dysphagia post burn

In the dysphagic cohort, severity of dysphagia at initial assessment was 41% severe, 31% moderate, and 28% mild (Table 5). Those with mild dysphagia presented with oral stage deficits alone, whilst individuals rated as having moderate or severe dysphagia (71%) presented with deficits in both the oral and pharyngeal stages of the swallow. Within the

dysphagic group, length of SLP intervention naturally increased with dysphagia severity, with patients diagnosed as having severe dysphagia requiring over three times the length of management of those who presented with mild dysphagia at initial assessment (Table 5).

/insert Table 5 near here/

Mapping of dysphagia resolution by severity for the dysphagic cohort during the course of their hospital admission is shown in Figure 2. Dysphagia resolution (of both oral and pharyngeal deficits) was observed to progress most rapidly in the 6 weeks post admission. By week 6, 50% of the cases resolved and by week 9, 75% of individuals had resolved. By discharge, dysphagia had resolved in 86% (n = 42) of participants, 10% (n = 5) had mild dysphagia, and 4% (n = 2) continued to present with moderate impairment of swallow function.

/insert Figure 2 near here/

At initial assessment, eleven participants were unsuitable to commence any oral intake and remained nil by mouth, whilst another 16% were commenced on small amounts of thickened fluids with supervision and were unable to manage any food consistencies/textures at that time. The remaining 61% of subjects were able to safely tolerate oral intake trials of both food and fluid. Following initial assessment, the clinical progression across fluid and food consistencies during recovery and return to oral intake is represented in Figure 3 (fluid consistencies) and Figure 4 (food textures). Analysis of the weekly patterns revealed that safe management of thin fluids occurred in over 50% of individuals between weeks 4 and 5 post injury (Figure 3). By week 7, greater than 75% of

dysphagic individuals had successfully returned to thin fluids. The majority of participants (96%) had achieved thin fluid diet status by week 12. By discharge, 97% of the group were safely managing thin fluids. Only one patient continued to present with aspiration on thin fluids by discharge.

In comparison, progression towards normal food textures was not as expeditious, with persisting oral phase difficulties being apparent within the cohort (Figure 4). Although, 57% of dysphagics had begun consumption of food by week 3 post injury, the majority (49%) were on modified diet textures. It was not until week 6 that over 50% of individuals achieved a general diet. Whilst return to normal food textures was somewhat prompter for those with less severe burn injuries, consumption of modified texture diets continued, with the number of participants progressing towards normal food textures increasing gradually up until week 16 post admission. By discharge, all dysphagic subjects were able to safely ingest an oral diet consistency/texture. However, 7 patients continued to require texture modification. Three required a soft diet due to poor dentition, while a further 2 had mild tightness at the oral commissures and preferred soft texture diets for ease of chewing and to limit discomfort/fatigue throughout the course of a meal. One participant required a minced diet due to a combination of poor dentition, fatigue and orofacial tightness all impacting upon the oral stage of the swallow. One patient was discharged on a pureed diet due to severe orofacial contractures that limited mouth opening and ability to adequately masticate and manipulate food for safe consumption. Three of these individuals received ongoing intensive dysphagia management post discharge.

/insert Figures 3 and 4 near here/

Discussion

Clinical presentation within the thermal burn population is complex, as is the nature of patient recovery. The current data highlights that SLP management for those with dysphagia can be protracted, extending for many weeks post injury. Whilst most clinical gains will be found to occur in the period between the 2nd to 6th weeks post injury, almost a third of patients can be expected to require ongoing management beyond this period. In addition, chronic dysphagia will be a reality for a small proportion, with 15% of the current cohort requiring ongoing dysphagia management and SLP follow-up at discharge, largely due to oral stage deficits caused by severe orofacial contractures. The current study has established the first set of prospective cohort data, providing both clinical profiles of dysphagic and non-dysphagic groups and information regarding the natural course of dysphagia recovery in the thermal burn population. This information will aid patients and service providers alike in planning for rehabilitation.

The present study established that there are significant differences in injury presentation and subsequent management requirements for those who present with dysphagia from those who have intact swallow function following thermal burn injury. Non-dysphagics presented with less severe injuries that required fewer days or no time in critical care, thus allowing resumption of oral intake to be expeditious, and the need for and duration of supplementary feeding being significantly less. In the current study, the DIOF for the majority of non-dysphagics was prior to the initial SLP assessment (0.08 +/- 0.59 versus 2.56 +/- 2.89 days) as dysphagia risk was calculated as low, using a

dysphagia screener administered by trained nursing staff on admission. Factors that increase dysphagia risk post thermal burn have been established²³ and should be incorporated into admission screening tools in burn centers to aid in correct identification of the small subset of patients at high risk of dysphagia who require specialised SLP assessment and management.

The dysphagic subgroup in this study received initial contact with SLP within 2 weeks of hospital admission, a time period approximately four times longer than that for those who were classified as non-dysphagic. The delay between admission and the commencement of SLP intervention observed in the present burns group, like the dysphagic burns populations retrospectively studied before it¹¹⁻¹³, is a reflection of severity of burn injury and associated protracted periods of medical instability. The initial stage of acute burn management focuses on achieving medical and ventilatory stability^{27,28} and during this period patients often undergo repeated debridement and grafting procedures. Furthermore, a high percentage of inhalation injury and/or large TBSA affected that necessitated mechanical ventilation via ETT and, in some cases, the need for a tracheostomy was evident in the current dysphagic cohort. Consequently, fluctuating medical states within the first weeks of admission are not always conducive to early commencement of dysphagia assessment, treatment and rehabilitation^{7,10,13,23}.

The results of the present study revealed a mean duration of 18 days until DIOF in the dysphagic cohort. When comparing the current study to those of Edelman et al¹¹ and McKinnon DuBose et al¹², it is striking that mean days to SLP consultation and DIOF in their studies was three times greater than that required for the current sample. Some part of this finding could be attributed to differences in international healthcare settings, with

variation in practice policies regarding patient accessibility. Indeed, when comparing the current data to those from Ward and colleagues¹³ which was conducted in the same facility as the current study, reported durations only 1.5 times longer than the current study (Initial assessment, M = 20 days; DIOF, M = 30 days). Other factors which could account for the relatively shorter duration to initial assessment and oral feeding in the current cohort may also be the overall severity of the participants' injuries. In the earlier studies, the patient populations had larger %TBSA than the current cohort¹¹⁻¹³ and thus along with this greater injury severity comes longer dependence on mechanical ventilation, intubation and longer delays to initiation of feeding. Finally changes in medical practice and availability of SLP services may also be a factor. Particularly in Ward et al's¹³ study, their data reflects practice of almost a decade prior to the current research, and at the time SLP services were one quarter of the dedicated service that now exists in that setting. Hence, it is possible that the advancements made in medical management procedures and the increased role of SLP in burn care management over the last decade may also have contributed to the early commencement of oral intake observed in the current cohort.

DTOF in the dysphagic group was not achieved until a mean of 33 days post injury. This period was 17 days shorter than data reported a decade ago by Ward et al¹³. It is important to note that need for supplemental feeding in this population is exclusive of aspiration risk and ultimate duration of supplementary feeding may or may not be solely dependent on the severity of the burn injury and the hypermetabolic response. Therefore, the difference seen with supplementary feeding durations between

the current study and the one conducted at the same centre by Ward and colleagues¹³ may be attributable to larger TBSA injuries being seen in Ward et al's¹³ cohort.

The present findings revealed that 50% of the cohort had resolved by week 6 and over 75% by week 9. During this period, the recovery curve for dysphagia was observed to be steepest for the first 6 weeks post burn. This data provides important insights into patterns of service demand, highlighting the need to prioritise patients at dysphagia risk post thermal burn for early assessment of dysphagia, followed by continual monitoring and intervention for at least 2 to 3 months post injury. Duration of SLP management was also observed to increase considerably with severity. Thus, considering that over 70% of the dysphagic group presented with moderate to severe dysphagia at the initial time of assessment, lengthy periods of SLP intervention can be anticipated for most patients. Diagnostic management and dysphagia rehabilitation in the acute period (especially in ICU) is often hindered by the complexity created by fluctuating medical states, and need for ventilation and intubation, thus protracting recovery time. During this period, dysphagia management is typically approached conservatively and continual patient monitoring is required, usually on a daily basis.

Return to oral intake must be considered for this particular clinical population from two domains: resolution of aspiration risk and orofacial burn wound healing. In particularly complex cases, oropharyngeal dysphagia management has been reported to continue for numerous months during inpatient stays and post hospital discharge, with the prospect of long-term supplementary feeding^{7,8,10-13,29}. Previous single case studies^{7,10} have alluded to the ongoing oral stage deficits being solely attributable to the persistence of oral scars and contractures. These cases also highlight comparatively earlier resolution

of pharyngeal stage dysphagia (i.e., the elimination of aspiration risk) to oral stage deficits. This is also evidenced in the current study, with a discrepancy noted between return to safe intake of fluids versus foods, largely due to persistent oral stage deficits limiting safe management of normal food textures. In the presence of orofacial scarring and contractures, individuals frequently present with poor lip seal, microstomia and restricted facial movement^{7,10,12,30-32} that limit ability for safe and successful oral intake. Although some degree of oral intake can usually be introduced successfully and safely for patients with orofacial contractures, deficits remain that require further intensive rehabilitation and such deficits may prevent the return to normal dietary textures by hospital discharge^{7,10}. In the current cohort, 7 individuals were unable to resume normal food textures by discharge due to oral stage deficits.

The present study has established that resolution of swallowing impairment and return to oral intake can be quite protracted with a small proportion of individuals continuing to be dysphagic in the long term. In the current cohort, dysphagia resolved in >75% of patients by week 9 post injury and 85% had resolved by discharge. This is not unlike the findings from the retrospective study by Ward et al¹³, conducted in the same centre nearly a decade previously. However, reports from the USA^{11,12} differ, with their cohorts exhibiting much lower rates of dysphagia resolution by discharge (39.3%-45%) despite having relatively comparable length of hospital stay (range 44-85 days) to the current cohort (M = 56 days). Reasons for this difference cannot be explained by the current data.

Conclusion

The present study has provided the first step towards achieving a systematic, prospective evidence base regarding the impact of dysphagia on return to oral intake in adult patients post thermal burn injury. Those who presented with dysphagia in the current cohort had increased severity of injury and need for critical care admission, creating a multifaceted platform for dysphagia presentation. Overall the data confirms that dysphagia recovery is protracted over months post injury and SLP management is often very lengthy, particularly for those with more severe dysphagia. Recovery however can be anticipated for over 50% of patient by week 6 and 75% by week 9. Only about 15% will continue to have dysphagia by discharge, largely due to the presence of orofacial contractures. The current data will assist clinicians to determine probable prognoses for swallowing recovery and resolution post burn injury. The data will also enable service providers to better estimate the ongoing demand for clinical resources, and help optimise appropriate timing and resource allocation of SLP services with this population. Future research is needed to define the causal relationships between the initial presentation of the injury and resolution of dysphagia to further enhance prognostic decision-making and refine service delivery models.

Acknowledgements

The authors gratefully acknowledge funding support for this study from the Royal Brisbane and Women's Hospital Foundation. We acknowledge the assistance of the Royal Brisbane and Women's Hospital Professor Stuart Pegg Adult Burns Unit in the

recruitment of participants for this study. Finally, the authors wish to acknowledge the participants of this study for their patience, determination, willingness to help teach others and the generous gift of their time.

References

1. Bartlett, R.M., Niccole, M., Tavis, M.J. et al. (1976). Acute management of the upper airway in facial burns and smoke inhalation. *Archives of Surgery*, 111(7), 744-749.
2. Clark, W.R. (1992). Inhalation Injury. In L.T.A. Rylah (Ed.), *Critical care of the burned patient*. Wiltshire: Cambridge University Press.
3. Gaissert, H.A., Lofgren, R.H., & Grillo, H.C. (1993). Upper airway compromise after inhalation injury: Complex strictures of the larynx and trachea and their management. *Annals of Surgery*, 218(5), 672-678.
4. Guelrud, M., & Arocha, M. (1980). Major function abnormalities in acute caustic esophagitis. *Journal of Clinical Gastroenterology*, 2(3), 247-250.
5. Lee, M.G., Sing, M.Y., Venugopal, S. et al. (1990). Caustic strictures of the oesophagus. *West Indian Medical Journal*, 39(4), 245-249.
6. Rao, K.S., Ananthkrishnan, N., & Banerjee, A. (1988). Corrosive oesophagitis: An analysis of 50 cases. *Australian and New Zealand Journal of Surgery*, 58(9), 723-726.
7. Rumbach, A.F., Ward, E.C., Cornwell, P.L. et al. (2009). The challenges of dysphagia management and rehabilitation after extensive thermal burn injury: A complex case. *Journal of Burn Care and Research*. 30(5), 899-903.
8. Rumbach, A.F., Ward, E.C., McKinnon DuBose, C. et al. (2009). Burn Injury. In E.C. Ward & A.T. Morgan (Eds.), *Dysphagia post trauma* (pp. 151-199). San Francisco: Plural Publishing.

9. Clayton, N.A., & Kennedy, P.J. (2007). Management of firecracker induced oropharyngeal burns: a case report. *Advances in Speech-Language Pathology*, 9(3), 265-270.
10. Rumbach, A.F., Ward, E.C., Cornwell, P.L. et al. (2011). Dysphagia management and rehabilitation: an interdisciplinary and multidisciplinary collaborative. *Journal of Medical Speech-Language Pathology*.19(1), 25-34.
11. Edelman, D.A., Sheehy-Deardorff, & White, M.T. (2008). Bedside assessment of swallowing is predictive of an abnormal barium swallow examination. *Journal of Burn Care and Rehabilitation*, 29(1), 89-96.
12. McKinnon DuBose, C., Groher, M.G., Carnaby Mann, G.S. et al. (2005). Pattern of dysphagia recovery after thermal burn injury. *Journal of Burn Care and Rehabilitation*, 26(3), 233-237.
13. Ward, E.C., Uriarte, M., & Conroy, A-L. (2001). Duration of dysphagic symptoms and swallowing outcomes after thermal burn injury. *Journal of Burn Care and Rehabilitation*, 22(6), 441-453.
14. Barnes, M.P. (1999). Rehabilitation after traumatic brain injury. *British Medical Bulletin*, 55, 927-943.
15. Brigham, P.A., & McLoughlin, E. (1996). Burn incidence and medical care use in the United States: Estimates, trends, and data sources. *Journal of Burn Care and Rehabilitation*, 17, 95-107.
16. Duggan, D., & Quine, S. (1995). Burn injuries and characteristics of burn patients in New South Wales, Australia. *Burns*, 21(2), 83-89.

17. Garner, W.L., & Reiss, M. (2005). Burn care in Los Angeles, California: LAC + USC experience 1994-2004. *Burns*, 31S, S32-S35.
18. MacLeod, A. (1970). Adult burns in Melbourne: A five-year survey. *The Medical Journal of Australia*, 2, 772-777.
19. Masterton, J.P., Pressley, T.A., & Ramsay, G. et al. (1979). A survey of adults with flame burns at a Melbourne hospital. *The Medical Journal of Australia*. 1, 332-336.
20. Nicol, J., & Rudd, M. (2004). *Royal Brisbane and Women's Hospital Burns Unit: 1972-2004 Mortality and Determinants of Death*, Brisbane, QLD: RBWH Burns Unit, University of Queensland.
21. Pegg, S.P. (2005). Burn epidemiology in the Brisbane and Queensland area. *Burns*, 31S, S27-S31.
22. Saffle, J.R., Davis, B., Williams, P. et al. (1995). Recent outcomes in the treatment of burn injury in the United States: A report from the American Burn Association Patient Registry. *Journal of Burn Care and Rehabilitation*, 16, 219-232.
23. Rumbach, A.F., Ward, E.C., Cornwell, P.L. et al. (in press). Incidence and predictive factors for dysphagia following thermal burn injury: A prospective cohort study. *Journal of Burn Care and Rehabilitation*.
24. Dieticians Association of Australian and the Speech Pathology Association of Australia Limited. (2007). Texture-modified foods and thickened fluids as used for individuals with dysphagia: Australian standardised labels and definitions. *Nutrition and Dietetics*, 64(S2), S53-S76.

25. Shearer, W.M. (1982). *Research procedures in speech, language and hearing*. Baltimore: Williams & Wilkins.
26. Yiu, E.M-L. (2002). Impact and prevention of voice problems in the teaching profession: embracing the consumers' view. *Journal of Voice*, *16*(2), 215-228.
27. DeSanti, L., Lincoln, L., Egan, F., & Demling, R. (1998). Development of a burn rehabilitation unit: Impact on burn center length of stay and functional outcome. *Journal of Burn Care and Research*, *19*, 414-419.
28. Rose, D. D., & Jordan, E. B. (1999). Perioperative management of burn patients. *Association of periOperative Registered Nurses Journal*, *69*(6), 1211-1222.
29. Clayton, N., Kennedy, P., & Maitz, P. (2010). The severe burns patient with tracheostomy: Implications for management of dysphagia, dysphonia and laryngotracheal pathology. *Burns*, *36*(6), 850-855.
30. Casper, J., Clark, W.R., Kelley, R.T., & Colton, R.H. (2002). Laryngeal and phonatory status after burn/inhalation injury: A long term follow-up study. *Journal of Burn Care & Rehabilitation*, *23*(4), 235-243.
31. Heinle, J.A., Kealey, G.P., Cram, A.E., & Hartford, C.E. (1988). The microstomia prevention appliance: 14 years of clinical experience. *Journal of Burn Care and Rehabilitation*, *9*(1), 90-91.
32. Shikowitz, M.J., Levy, J., Villano, D., Graver, M.L., & Pochaczewsky, R. (1996). Speech and swallowing rehabilitation following devastating caustic ingestion: Techniques and indicators for success. *Laryngoscope*, *106*(2), 1-12.

Table 1

Burn Specific Dysphagia Severity Rating Scale (based on levels of oral intake restriction)

Severity Level	Criteria
Mild	<ul style="list-style-type: none"> • Requires one level of restriction in either the food or fluid category (e.g., regular thin fluids and a soft diet) • Able to safely consume the majority of the modified texture meal
Moderate	<ul style="list-style-type: none"> • Requires one or more levels of restriction to both fluid and food consistencies required to minimise aspiration risk (e.g., mildly thick fluids and puree solids) • Able to safely consume at least half of modified texture meal
Severe	<ul style="list-style-type: none"> • High aspiration risk for all food and fluid consistencies • Patient placed nil by mouth, +/- small trials only of extremely thick fluids or puree consistency food

Table 2

Biographical details and information regarding initial injury presentation for dysphagic (n = 49) and non-dysphagic cohorts (n = 389)

Population Variable	Dysphagic		Non-dysphagic		P-Value*
	N	%	N	%	
Gender					
Male	41	83.67	307	78.92	0.438
Female	8	16.33	82	21.08	
Injury etiology					
Flame	29	59.18	130	33.42	0.135
Scald	3	6.12	113	29.05	
Combination	13	26.53	58	14.91	
Contact	1	2.04	46	11.83	
Flash	3	6.12	42	10.79	
Presence of head and neck burns	41	83.67	99	25.45	<0.01
Inhalation injury	26	53.06	4	1.03	<0.01
	Mean (SD)	Range	Mean (SD)	Range	
Age (years)	42.63 (19.53)	14-85	37.78 (17.06)	13-90	0.06
% TBSA burned	31.43 (16.95)	1.5-67.5	7.82 (7.58)	0.5-48	<0.01

* P values are based on chi-square and t-tests.

Table 3

Hospitalisation and treatment periods post thermal burn injury for dysphagic (n = 49) and non-dysphagic cohorts (n = 389)

Population Variable	Dysphagic Mean (SD)	Range	Non-dysphagic Mean (SD)	Range	P-Value*
LO ETT (days)	11.23 (6.83) ^a	1-24	2.33 (2.24) ^b	1-7	<0.01
Ventilation period (days)	13.77 (10.51) ^a	1-41	2.12 (2.42) ^b	0-7	<0.01
Conversion from ETT to tracheostomy (days)	16.125 (6.96) ^c	4-24	N/A ^d	N/A	N/A
Duration of tracheostomy (days)	47.875 (34.74)	7-101	N/A ^d	N/A	N/A
LOS ICU (days)	15 (11.61) ^a	0-43	2.16 (2.20) ^e	0-9	<0.01
LOS Burn Unit (days)	42.31 (30.81)	7-158	12.16 (10.28)	1-119	<0.01
LOHS (days)	56.45 (37.5)	11-198	12.16 (10.17)	1-119	<0.01

Note: ETT = endotracheal tube; ICU = intensive care unit; LOHS = length of hospital stay; LOS = length of stay

^a n = 45, ^b n = 9, ^c n = 8, ^d n = 0, ^e n = 17

* P values are based on chi-square and t-tests.

Table 4

Speech-language pathology and nutrition information for dysphagic (n = 49) and non-dysphagic cohorts (n = 389)

Population Variable	Dysphagic		Non-dysphagic		P-Value*
	Mean (SD)	Range	Mean (SD)	Range	
Days to SLP referral	13.61 (11.44)	1-45	2.56 (2.89)	0-33	<0.01
DIOF	18.77 (21.19)	0-116	0.08 (0.59)	0-8	<0.01
Duration of supplementary feeding (days)	34.23 (26.78) ^a	1-117 ^{**}	9.55 (6.97) ^b	1-23	<0.01
DTOF	33.55 (26.53)	2-117	0.54 (2.83)	0-24	<0.01
DI-TOF	14.80 (14.29)	0-66	0.46 (2.64)	0-24	<0.01
Duration of SLP intervention	29.16 (32.56)	1-162 ^{***}	N/A ^c	N/A	N/A

Note: DIOF = days to initiation of oral feeding; DI-TOF = days between initiation of oral feeding to total oral feeding; DTOF = days to total oral feeding; SLP = speech-language pathology.

^a n = 48, ^b n = 20, ^c n = 0

* P values are based on chi-square and t-tests.

** 3 participants discharged with ongoing supplementary feeding requirements

*** 2 participants discharged with the need for ongoing intensive SLP intervention

Table 5

Breakdown of dysphagia presentation, severity and associated length of SLP treatment

Dysphagia Type	Dysphagia Severity at Initial Assessment	LOS SLP (days)
Oral	Mild (n = 14)	M = 13.71 (SD = 10.99) Range = 1-35
Oropharyngeal	Moderate (n = 15)	M = 17.43 (SD = 17.43) Range = 4-75
	Severe (n = 20)	M = 47.05 (SD = 42.40) Range = 4-162

Note: LOS SLP = length of speech-language pathology intervention

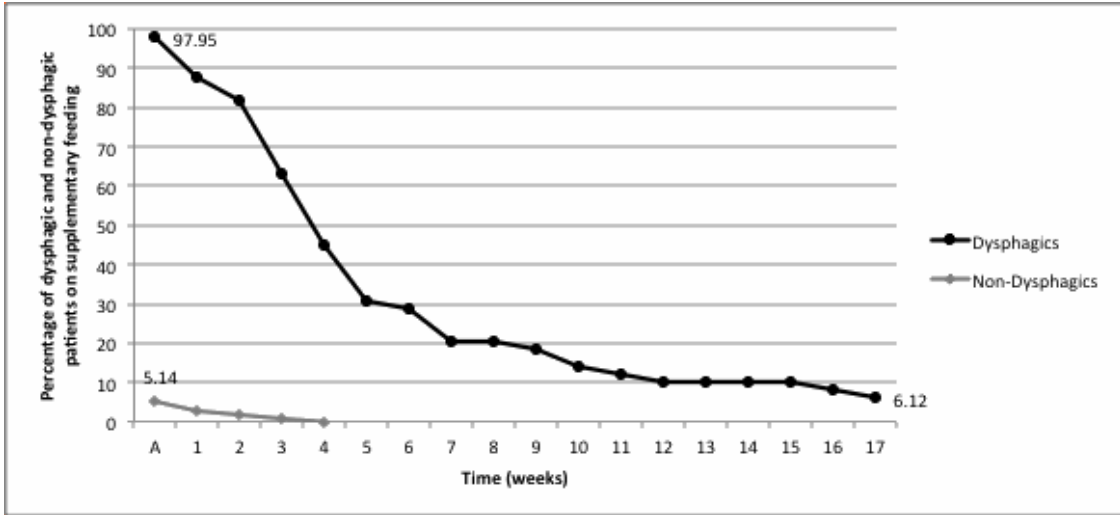


Figure 1

Cessation of supplementary feeding over time for dysphagic and non-dysphagic subjects post thermal burn

Note: A = admission

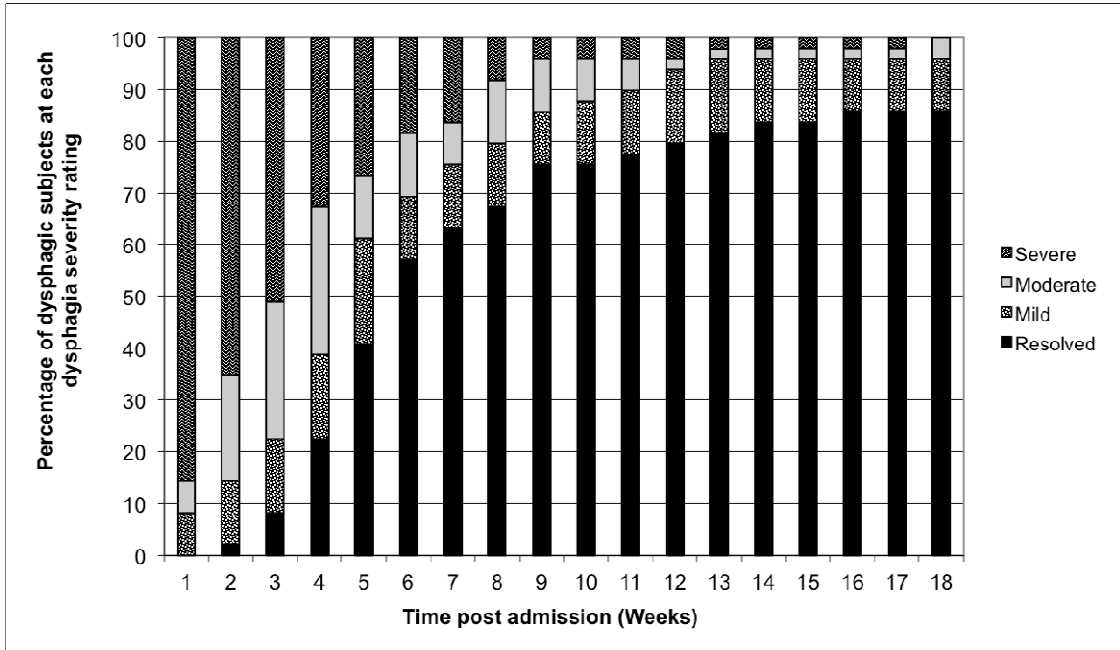


Figure 2

Ranking of dysphagia severity during progression towards dysphagia resolution and hospital discharge for 49 dysphagic subjects post thermal burn injury

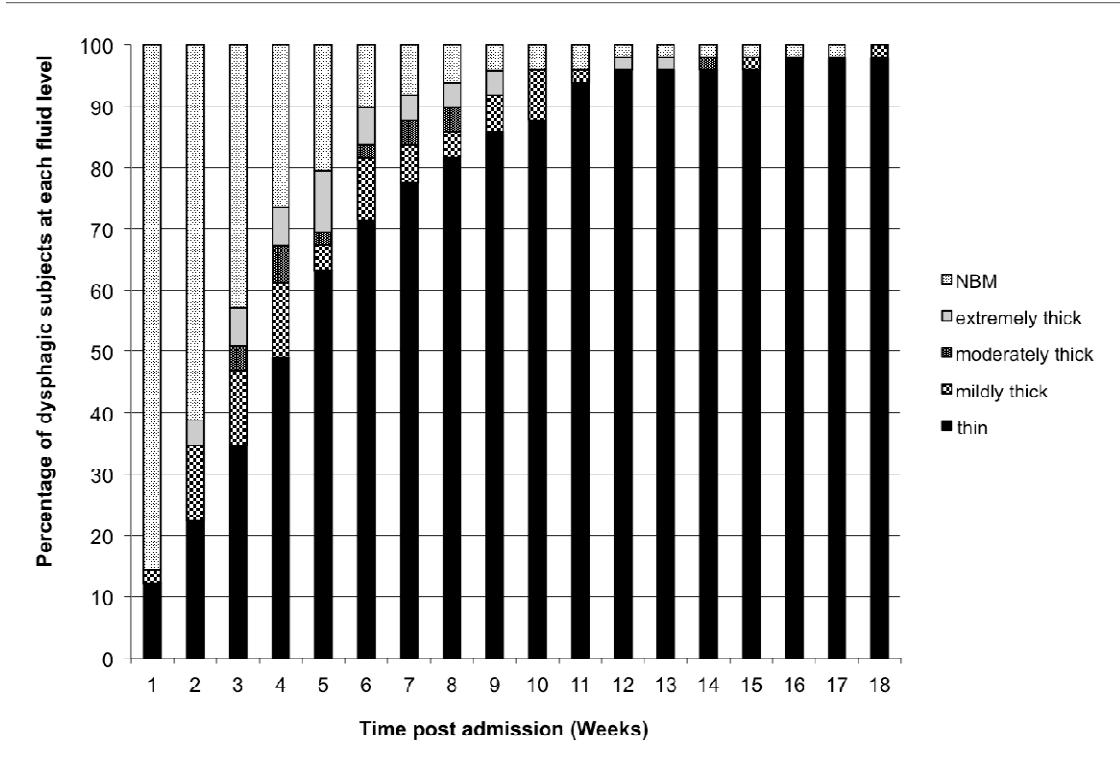


Figure 3

Return to normal fluid consistencies over time for 49 subjects with dysphagia post thermal burn

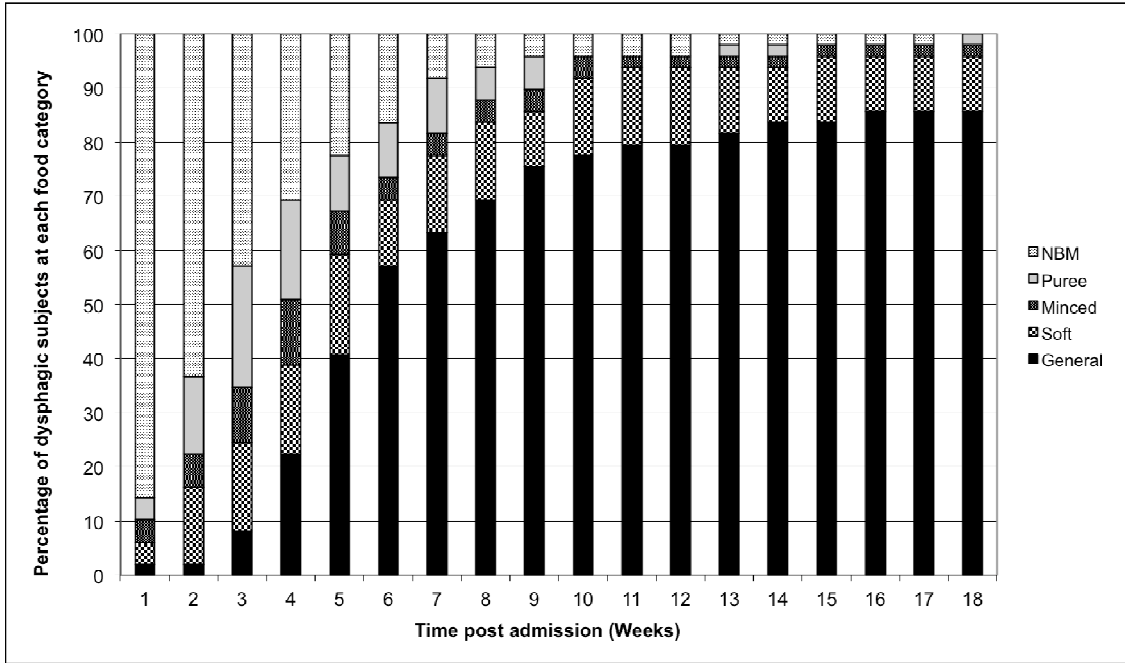


Figure 4

Return to normal food consistencies over time for 49 subjects with dysphagia post thermal burn

