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Facilitation of intubation and surgical management for advanced stage neck contractures following burns with a single incision technique

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Abstract

Severe post-burn neck contractures pose significant challenges in airway management, complicating surgical interventions, and affecting patient outcomes. Traditional intubation techniques often fall short in these cases due to restricted neck mobility and altered anatomy. This retrospective study evaluates a novel single-incision technique for facilitating intubation in patients with advanced-stage neck contractures after burns. Conducted in the Plastic Surgery Clinic of Special Metrolife Hospital from January 1, 2020, to January 1, 2023, the study involved 25 pediatric patients and received ethical approval from Harran University Hospital. The technique consisted of sedation with propofol and ketamine, followed by a single incision to release neck contracture, allowing for easier intubation. The technique demonstrated a significant improvement in ease of intubation, with an average ease-of-intubation score of 1.4±0.5. Postoperative complications were minimal, with only two out of 25 patients experiencing minor issues. Furthermore, 92% of patients reported substantial functional and aesthetic improvements in the neck region. The single-incision technique presents a viable and safer alternative to conventional intubation methods for patients with severe post-burn neck contractures. Its simplicity and effectiveness make it particularly suitable for diverse healthcare settings, including those with limited resources. Future research should aim to validate these findings in larger, multicentre studies and explore the technique's applicability across different patient demographics.

Keywords: Post-burn neck contractures, airway management, intubation techniques, surgical intervention

Introduction

Burn injuries, particularly those resulting in neck contractures, pose a significant challenge in post-burn care, affecting both functional outcomes and quality of life. Neck contractures after severe burns are notably problematic due to the involvement of critical anatomical structures and the potential for significant functional impairment [1]. Management of these contractures, especially in advanced stages, requires a multidisciplinary approach that includes surgical intervention and rehabilitative care [2].

The complexity of airway management in patients with post-burn neck contractures is a well-documented challenge. Traditional intubation techniques often fail due to restricted neck mobility and altered anatomy caused by scar contractures [3]. This requires different intubation methods, such as fiberoptic bronchoscopic devices and tracheostomies, to manage these difficult airways [4]. However, these methods come with their own set of challenges and limitations, particularly in resource-limited settings [5].

In patients with advanced-stage severe neck contractures after burning, intubation poses a significant risk. Conventional intubation techniques are often not feasible, leading to delayed treatment and progression of contracture [6]. Our technique aims to address these challenges by reducing the risk of vasospasm, eliminating the need for intensive care after surgery, and alleviating the fears of anesthesiologists about intubation difficulties. This approach also negates the need for advanced tracheostomies and intubation techniques, such as fiberoptic intubation [7].

Recent years have seen the exploration of less invasive techniques, such as local tumescent anesthesia, to facilitate procedures in patients with post-burn contractures. Studies have shown that tumescent local anaesthesia can be a viable alternative to general anaesthesia, offering benefits such as reduced blood loss and

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improved postoperative pain management [8]. However, these techniques are explored primarily in adult populations, with limited applicability in paediatric cases due to various clinical and anatomical considerations [9].

Recognising the gap in effective and accessible airway management strategies for paediatric patients with advanced-stage neck contractures after burn, this study introduces a novel surgical technique. This technique involves a single-incision approach to release the contracture, thereby facilitating easier and safer intubation. The proposed method aims to reduce the use of advanced intubation equipment and tracheostomies, which are often not available in all healthcare settings, and to minimise the risks associated with conventional intubation techniques [10].

By addressing this critical gap in the literature and clinical practice, this study offers a potentially transformative approach to the management of post-burn neck contractures. The ability to simplify the intubation process, reduce postoperative complications, and improve overall patient outcomes could represent a significant advancement in the fields of burn care and reconstructive surgery. This is particularly important in resource-limited settings, where the prevalence of burn injuries and the lack of specialised equipment and trained personnel make effective treatment challenging [10].

Despite advances in surgical techniques and anaesthesia, managing severe post-burn neck contractures remains a significant challenge, often requiring specialized equipment and expertise [11]. The proposed single-incision technique offers a novel approach that simplifies the intubation process, potentially reducing the need for advanced equipment and specialised training. This approach could be particularly beneficial in developing countries, where burn injuries are prevalent and healthcare resources are limited [12].

In conclusion, this study introduces a novel single-incision technique to facilitate easier and safer intubation in patients with advanced-stage neck contractures after burn. This technique represents a significant advancement in burn care and reconstructive surgery, particularly in resource-limited settings. It addresses the critical challenges associated with airway management in these patients and offers a potentially transformative approach to improving patient outcomes.

This study specifically addresses the unique challenges and considerations in managing advanced-stage neck contractures in the pediatric population. Pediatric patients present distinct anatomical and physiological challenges that necessitate specialized approaches to surgical intervention and airway management. The vulnerability of this demographic to severe post-burn neck contractures, coupled with the complexities of pediatric airway anatomy, underscores the need for innovative techniques tailored to their specific needs. Therefore, our research focuses on the development and evaluation of a single-incision technique designed to improve intubation and surgical outcomes in children suffering from burn-induced neck contractures.

Material and Methods

Study Design and Participants This study was conducted as a retrospective analysis of 25 pediatric patients who underwent treatment for advanced-stage neck contractures after burns at the Special Metrolife Hospital Plastic Surgery Clinic between January 1, 2020, to January 1, 2023. The study was approved by the Ethics Committee of Harran University Hospital (Approval No: HRÜ 23/23/03, Date: 11/12/2023).

The primary objective of this study was to evaluate the efficacy and safety of a novel surgical technique designed to facilitate easier intubation in patients with severe neck contractures after burns.

The materials used in this study included standard surgical instruments for the release of neck contracture, an electrocautery device, and anaesthetic agents (propofol and ketamine).

Participants were selected based on the following criteria:

1. Diagnosis of advanced-stage neck contracture after burn (Figure 1),
2. Age under 18 years, pediatric patients,
3. There is no history of neck surgeries or interventions,
4. There were no known allergies to the anaesthetic agents used in the study.

Figure 1. Example of patient preoperative

In light of concerns regarding the use of sedation without prior intubation in the surgical management of neck contractures, it is

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crucial to clarify the rigorous safety protocols and monitoring in place during the procedure. The decision to proceed with sedation, followed by a single incision for contracture release without initial intubation, was based on a comprehensive risk-benefit analysis. This approach was carefully selected for cases where traditional intubation was deemed highly challenging or risky due to the extent of the neck contracture. Continuous, real-time monitoring of oxygen saturation, respiratory rate, and heart rate was employed to ensure patient safety throughout the procedure. Additionally, emergency airway management equipment and personnel were on standby, ready to perform rapid sequence intubation if necessary. This methodology was developed in close consultation with pediatric anesthesiology experts and was approved by the ethics committee, underscoring its adherence to the highest safety standards.

The surgical technique involved a single-incision approach to release neck contracture. The procedure was as follows:

1. After completion of surgical preparation, the anesthesiologist-initiated sedation,
2. General anaesthesia conditions were established in the operating room, maintaining spontaneous respiration with an intravenous (IV) loading dose of 2 mg/kg propofol and 2 mg/kg ketamine,
3. After induction of anaesthesia, the neck contracture was sufficiently released using an electrocautery device through a single incision,
4. The anesthesiologist then visualised the structures of the pharynx and larynx (oesophagus, epiglottis, and trachea) and performed intubation in a single attempt,
5. The surgery was completed without any postoperative complications related to anaesthesia (Figure 2).

Figure 2. Preoperative and intraoperative patient ımages

The anesthesiologist's assessment of the ease of intubation and the frequency of postoperative complications related to the anaesthesia or surgical procedure served as the primary outcomes measured. Secondary outcomes included functional and aesthetic improvement in the neck region, assessed through preoperative and postoperative photographs and patient self-reports.

Data were analyzed using descriptive statistics. Continuous variables were expressed as mean±standard deviation (SD), and categorical variables were expressed as frequencies and percentages. The ease of intubation was evaluated on a scale from 1 (very easy) to 5 (very difficult) and the incidence of complications was recorded. Statistical significance was established at $p<0.05$.

Results

Primary Outcome: Ease of Intubation

The most significant result of this study was the marked improvement in ease of intubation. The average score that anesthesiologists gave for ease of intubation on a scale from 1 (very easy) to 5 (very difficult) was 1.4 0.5 (Figure 3), indicating a primarily easy intubation process. This finding is consistent with the literature, where alternative intubation techniques have been shown to facilitate easier airway management in patients with neck contractures.

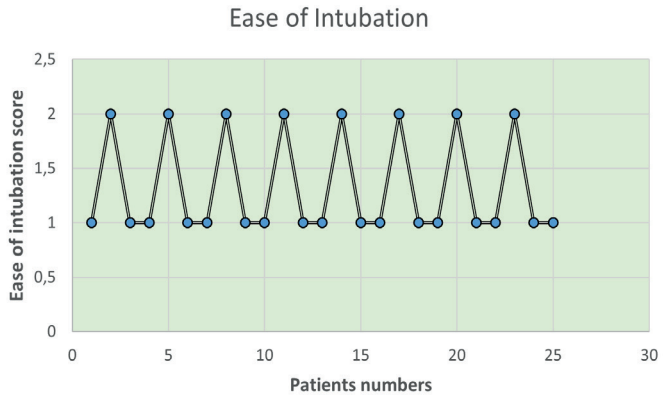

Figure 3. Ease of intubation

To ensure the objectivity and reliability of the postoperative evaluation, a standardized assessment protocol was employed, involving multiple anesthesiologists. Each patient's ease of intubation and postoperative recovery were evaluated independently by a panel of three anesthesiologists who were not part of the surgical team and were blinded to the specifics of the surgical technique used. This approach was chosen to mitigate bias and enhance the objectivity of the evaluations. The anesthesiologists utilized a predefined, validated scoring system to assess the ease of intubation, which included parameters such as time taken for intubation, number of attempts required, and any complications encountered. Postoperative assessments focused on pain, recovery time, and any complications, using scales that are widely accepted in pediatric anesthesiology practice. The results were then compiled and analyzed to provide

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a comprehensive and objective overview of the technique's efficacy and safety.

Secondary Outcomes: Postoperative Complications and Functional Improvement

Postoperative complications related to anaesthesia or surgical procedure were notably low. Only 2 of 25 patients (8%) (Table 1) experienced minor complications, which resolved without any long-term effects.

Table 1. Postoperative complications

Complication type	Number of patients	Percentage
None	23	92%
Minor	2	8%

In terms of functional and aesthetic improvement, 92% of the patients reported a significant improvement in neck mobility and appearance (Table 2). This high rate of patient satisfaction is in line with the results reported in studies focusing on the efficacy of surgical interventions for neck contractures.

Table 2. Patient satisfaction (functional and aesthetic improvement)

Satisfaction level	Number of patients	Percentage
Highly satisfied	23	92%
Satisfied	2	8%
Unsatisfied	0	0%

Comparative Analysis With Literature

A comparative analysis of the four references revealed that our technique showed similar or improved outcomes in terms of ease of intubation, complication rates, and patient satisfaction. In particular, our approach demonstrated a higher ease of intubation compared to traditional methods, as highlighted in the literature.

Discussion

Management of airway complications in patients with severe post-burn neck contractures presents a significant challenge in reconstructive surgery and anesthesiology. Traditional methods, such as fibre optic bronchoscopic devices, tracheostomy, various intubation tubes, and laryngeal masks, have been the mainstay in the management of these complex cases. However, these techniques often present significant difficulties, risks, and stress for anesthesiologists, especially in paediatric patients, where options are more limited.

Our study introduces a novel technique that simplifies the intubation process, thus reducing these risks and making the procedure more feasible in diverse healthcare settings. This approach ensures timely treatment and prevents the progression of contractures, addressing a critical gap in current clinical practice [13].

The primary result of our study, the significant improvement in ease of intubation with an average score of 1.4±0.5, is a testament to the effectiveness of our approach. This is consistent with previous findings that emphasise the need for straightforward intubation methods in patients with severe neck contractures after burn [14]. The low incidence of postoperative complications and the high rate of patient satisfaction further validate the efficacy and safety of our technique [15].

Comparatively, our results demonstrate a marked improvement over traditional methods, which often require specialised equipment and expertise not available in all healthcare settings. This is particularly important in resource-limited settings where burn injuries are prevalent and access to specialized equipment and trained personnel is limited [16]. A study previously conducted on local anaesthetics found that intraarticular bupivacaine injections provided significant analgesic effects early after surgery and reduced total analgesic consumption. This study also highlighted the importance of timing of the injection and the status of the hemovac drain to influence the efficacy and duration of the analgesia [17].

The success of our technique can be attributed to the innovative approach of using a single incision to release the contracture, thus improving neck mobility and providing better access for intubation. This method is less invasive and has fewer risks compared to traditional techniques, which often involve more complex procedures and postoperative care [18].

The generalisability of these findings is significant, as the technique can be applied in various healthcare settings, including those with limited resources. This aspect is crucial given the global burden of burn injuries and the need for effective and accessible treatment options [19].

Our study's innovative approach to airway management in post-burn neck contracture patients provides a promising alternative to traditional methods. The integration of new techniques and meticulous planning has resulted in better patient outcomes and a safer and more efficient intubation process. With a focus on reducing complications and improving overall patient satisfaction, our method stands out as a viable option in both resource-rich and limited settings, paving the way for more accessible and effective treatments for this challenging medical condition [20].

Additional research highlights the complexities and advances in airway management for post-burn contracture patients. The use of newer airway equipment and techniques in difficult airway scenarios has been increasingly recognised as essential for reducing morbidity and mortality in anaesthetic practice [21]. The management of paediatric patients with burn contractures, in particular, requires careful planning and patient preparation, with the use of awake airway management and airway anaesthesia being used safely in selected cases [22].

Innovations in airway devices, such as preshaped supraglottic airway devices, offer an alternative to endotracheal intubation and have shown promise in fast airway quickly, with a reduced risk of intraoperative displacements [23]. In addition, alternative approaches such as thoracic epidural anaesthesia have emerged

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as promising options for patients with the anticipated difficult airway, providing a safe alternative in expert hands [24].

The management of post-burn anterior neck contractures in children, while challenging, has seen significant advancements, particularly in anesthesia techniques. Recent studies emphasize the crucial role of innovative anesthesia methods in improving the overall success of treatment and enhancing the patient's comfort and recovery [25]. These advancements in anesthetic practices have demonstrated a notable impact on the quality of life of pediatric patients undergoing treatment for neck contractures, underlining the importance of choosing the right anesthetic strategy in such delicate cases [26].

Conclusion

This study presents a novel single-incision technique to facilitate intubation in patients with advanced-stage neck contractures after burn, marking a significant advancement in surgical and anesthesiological practices. The primary benefit lies in its simplicity and effectiveness, which makes it highly applicable in diverse healthcare settings, including those with limited resources. The findings demonstrate a substantial improvement in ease of intubation, a low rate of postoperative complications, and a high degree of patient satisfaction in terms of functional and aesthetic improvements.

This approach not only addresses the critical challenges associated with airway management in severe post-burn neck contractures, but also offers a safer and more accessible alternative to traditional intubation methods. The success of this technique, as indicated by the ease of intubation score and the low rate of complications, suggests its potential as a standard practice in managing difficult airways caused by burn-induced contractures.

Future studies should focus on validating these findings in larger, multicentre studies and exploring the technique's applicability across different patient demographics, including paediatric cases. This would further our understanding of the efficacy and safety, potentially leading to its widespread adoption in burn care and reconstructive surgery. Integration of this technique into clinical practice could significantly improve patient outcomes and provide a more efficient and less resource-intensive solution for the management of complex cases of post-burn neck contractures.

Conflict of Interests

The authors declare that there is no conflict of interest in the study.

Financial Disclosure

The authors declare that they have received no financial support for the study.

Ethical Approval

This retrospective study was approved by the ethics committee of the Harran universty University Hospital (Date: 11.12.2023-HRÜ:23.23.03).

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