

Techniques and Procedures

Improvising on the Fly: Comparison of a Novel Technique for Emergent Zipper Release to a Well-Established Technique in a Simulated Setting

Alex Piszker, DO,^{*,†} Jennifer Goodrich, DO,^{*,†} Tracy Koehler, PhD,^{*,†} and Ryan Offman, DO^{*,†}

^{*}Department of Emergency Medicine, Trinity Health—Muskegon, Muskegon, Michigan, and [†]Department of Osteopathic Medical Specialties, Michigan State University, College of Osteopathic Medicine, East Lansing, Michigan

Corresponding Address: Alex Piszker, DO, Department of Emergency Medicine, Michigan State University, College of Osteopathic Medicine, 965 Wilson Rd, East Lansing, MI 48824.

Abstract—Background: Penile skin zipper entrapment is an emergent medical condition in which the penile skin, scrotal skin, or foreskin gets caught within the teeth of a zipper or the slider itself. This can lead to complications such as urethral involvement, skin loss, or tissue necrosis. We propose a novel technique to aid in the release of entrapped skin utilizing wire cutters directed at the inferior portion of the zipper pull. **Objectives:** To describe a novel technique to free entrapped penile skin and compare its performance to the well-established median bar technique in a simulated setting. **Methods:** A randomized cross-over design was used to compare techniques on successful release, time to release and tissue injury using an animal model of raw chicken skin entrapped in a zipper. Statistical significance was assessed at $p < 0.05$. **Results:** Twenty-two participants were included. There was no statistically significant difference between the novel technique and the median bar technique regarding successful release (100% vs 95.5%, respectively), median time to release (29.1 vs 26.4 seconds, respectively), or frequency of tissue injury (22.7% vs 27.3%). **Conclusion:** Performance using our novel technique for removal of penile skin from a zipper is similar to the median bar release technique regarding. Our novel technique may be a valid treatment option for the release of entrapped penile skin in a zipper mechanism in the emergency department setting. © 2024 Elsevier Inc. All rights are reserved, including those for text and data mining, AI training, and similar technologies.

Keywords—zipper entrapment; emergency; urology; procedures; penis; foreskin

Introduction

Penile zipper entrapment is an emergent medical condition whereby the penile skin, scrotal skin, or foreskin gets caught in the teeth of a zipper or the slider itself (1). Entrapment generally occurs in children, as well as those who are in a rush to get dressed, those who forego underwear, or are intoxicated (2,3). Timely removal of the entrapped skin or penile tissue is of paramount importance as subsequent edema can make treatment more difficult. Significant complications such as urethral involvement, skin loss, and tissue necrosis are rare but do occur (2,3). A urology consultation is recommended if complications are present. Given the sensitive nature of the tissue involved, pain management, including consideration of a penile block, is generally recommended before attempting to free the entrapped tissue.

Established techniques for removing entrapped penile skin from zippers include using lubrication and subsequent manual release, cutting the median bar with wire cutters or similar tools, using a screwdriver to separate faceplates, using pliers to laterally compress the zip fastener, and removing the zipper's teeth using trauma shears (4). If application of lubrication and manual release fails, utilization of tools, specifically the median bar release technique is generally considered the next standard option (1,3,5). We propose a novel technique for releasing entrapped skin utilizing wire cutters directed at the inferior portion of the zipper pull rather than the median

bar. The objective of this pilot study was to describe our technique and determine its utility for freeing entrapped skin compared to the established median bar technique in a simulated setting.

Materials and Methods

Study Design

This pilot study utilized a randomized cross-over design to compare our novel release technique (NRT) to the median bar technique (MBT) using an animal model in a simulated setting. The institutional review board determined this to be non-human subjects research prior to study initiation.

Study Setting and Participants

The study was conducted at a simulation laboratory at a single-center teaching hospital in West Michigan during scheduled didactics, which included emergency medicine residents and attending physicians. The residency program has 28 residents and 10 core faculty members. Due to the limited number of potential participants and conflicts that arise with attending didactics, no formal sample size was calculated for this pilot study.

Release Techniques

Traditional median bar release (3): wire cutters are used to cut the median bar of the zipper, which is the piece of metal or plastic that connects both pieces of the body of the zipper pull (Figure 1). The median bar is generally the strongest part of the zipper mechanism. Without the median bar, the two plates of the body of the zipper pull will fall apart and allow the zipper teeth to be freely pulled apart.

The novel technique (Figure 2): This approach utilizes the inferior end of the zipper as it is open between the throats of the two bodies of the zipper pull. From an inferior direction the wire cutters are used to separate the plates of the body of the zipper pull. This causes the zipper to fall off the zipper teeth allowing for easy separation and freeing of the entrapped skin. Furthermore, we postulate the entrapped skin may be better protected from iatrogenic trauma caused by the enclosed portion of the zipper.

Study Procedures

Randomization

All participants performed both techniques. To account for order effects, participants were randomized into one of two groups (1) NRT first and MBT second or (2) MBT

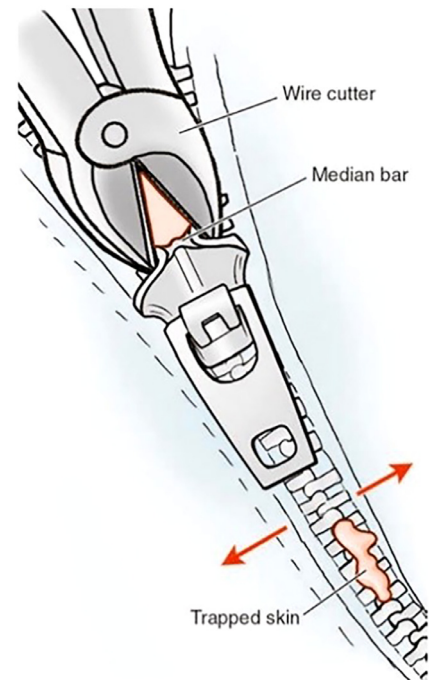


Figure 1. The median bar technique as pictured in Reichman's *Emergency Medicine Procedures* (3).

first and NRT second. As this pilot study utilized the number of participants who attended the didactic session, randomization occurred at the event and was achieved through a random number generator in Microsoft Excel. The investigators did not participate in the study to limit bias.

Animal model

Raw chicken wing skin was used to simulate the skin of the penis, scrotum, and foreskin. Chicken skin has been used as a model for scrotal/penile skin in previous research (4). Yoshida Kogyo Kabushikikaisha (YKK) brand zippers were used, as they are a commonly encountered clothing zipper manufacturer. The chicken skin was entrapped into the zipper for use in testing the release techniques. The same individual entrapped all skin samples into the zippers for consistency. DeWalt brand wire cutters were used for the release. Participants were randomized to release technique order groups to account for any bias related to performing one technique before the other. Participants were educated on both release techniques and were allowed to ask questions prior to performing the release.

Outcomes

Successful release: Defined as freeing the entrapped skin from a zipper within a 5-minute time allotment. For



Figure 2. The wire cutters are directed towards the inferior aspect of the zipper pull and target the space between the top and bottom plates of the zipper.

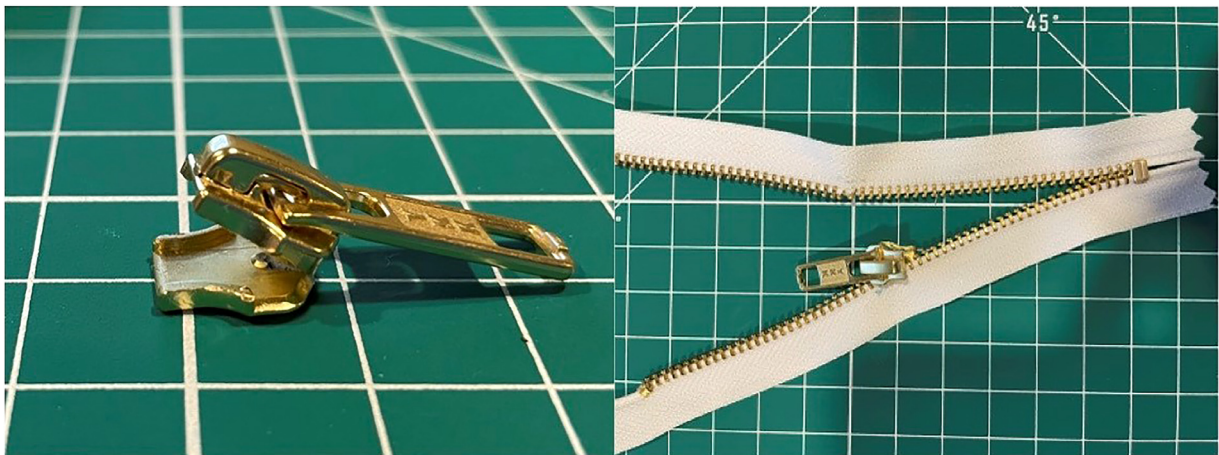


Figure 3. Demonstration of successful separation of zipper plates and subsequent zipper release.

the median bar technique, this meant completely cutting through the median bar and subsequent release of the chicken skin. For the novel technique, this meant separating the zipper body from the teeth of the zipper and subsequent release of the chicken skin (Figure 3).

Time to release: total time in seconds from the start of the attempt to the release of the chicken skin from the zipper. Time started after a countdown by the observer and ended with the release of the skin from the zipper or at the five-minute (300 second) mark, whichever came first. Time was measured using the stopwatch application on a smart phone.

Tissue injury: Damage to chicken skin due to release technique. This included any linear, full thickness tear in the chicken skin resulting from the removal technique or wire cutters. This was assessed by a single observer. If there was any uncertainty, an additional investigator was called to assess the tissue damage.

Data Analysis

Summary statistics were calculated. The Wilcoxon signed rank test was used to compare median time to release between the techniques. Data are shown as median, 25th, and 75th percentiles. Categorical data were compared using the chi-square test or Fisher’s exact test when appropriate. Significance was assessed at $p < 0.05$. Data were analyzed using IBM SPSS Statistics v.23 (IBM Corp, Armonk, NY).

Results

There were 22 participants (44 observations), 20 (90.9%) residents, 2 (9.1%) attendings. Eleven participants were randomized to perform the novel technique first and median bar release second and 11 were randomized to per-

Table 1. Participant Performance and Study Outcomes by Technique

Participant	MBT (sec)	NRT Time (sec)	MBT Success	NRT Success	MBT Injury	NRT Injury
1	29.00	39.26	Yes	Yes	No	Yes
2	64.21	11.39	Yes	Yes	No	No
3	8.61	3.60	Yes	Yes	No	No
4	53.31	36.63	Yes	Yes	No	No
5	45.11	19.90	Yes	Yes	No	No
6	9.98	24.70	Yes	Yes	No	No
7	39.20	84.41	Yes	Yes	Yes	Yes
8	20.90	81.06	Yes	Yes	No	No
9	300.00	159.69	No	Yes	Yes	No
10	8.40	57.01	Yes	Yes	No	Yes
11	36.52	47.24	Yes	Yes	No	Yes
12	11.20	18.71	Yes	Yes	No	No
13	7.22	21.79	Yes	Yes	No	No
14	21.21	33.46	Yes	Yes	No	No
15	4.40	15.00	Yes	Yes	No	No
16	23.79	8.24	Yes	Yes	No	No
17	19.51	17.00	Yes	Yes	No	No
18	31.67	21.81	Yes	Yes	No	No
19	32.33	65.05	Yes	Yes	Yes	Yes
20	275.36	72.22	Yes	Yes	Yes	No
21	35.07	10.20	Yes	Yes	Yes	No
22	11.02	41.61	Yes	Yes	Yes	No
Outcomes	26.4 [10.8, 40.7]*	29.1 [16.5, 59]*	95.5% (21) [†]	100% (22) [†]	27.3% (6) [†]	22.7% (5) [†]

MBT = median bar technique; NRT = novel release technique.

* Median [IQR = 25th, 75th percentiles]; $p = 0.439$.

[†] Percent (frequency); $p > 0.999$.

form the median bar release first and the novel technique second. There were no statistically significant differences in outcomes between the release techniques (Table 1). Successful release occurred in over 95% of the observations for both techniques (MBT 95.5% vs NRT 100%; $p > 0.999$), median time to release was less than 30 seconds for each technique (MBT 26.4 vs NRT 29.1; $p = 0.439$) and frequency of tissue injury occurred in less than 30% of observations using each technique (MBT 27.3% vs NRT 22.7%; $p > 0.999$).

Discussion

Various techniques to treat penile zipper entrapment have been recommended and described in emergency medicine literature. Manual removal involving the use of mineral oil, surgical lubricant, or viscous lidocaine is the first-line technique of choice as it has the lowest risk of tissue injury (3,4). If mineral oil is used, the skin should be allowed to soak for ten minutes, then gentle traction away from

the entrapped tissue can be performed (6,7). The most common recommendation of the secondary techniques is cutting the median bar of the zipper slider (5,8). A wire cutter can be used to cut the median bar that connects the upper and lower plates of the zipper slider. Cutting the median bar has been shown to have 43% to 77% rates of tissue injury depending on the experience of the clinician (4). Heavy duty zippers may be more resistant to being cut and may require a saw or Dremel tool (9). However, using power tools for removal inherently increases the risk of injury. Based on concerns for tissue damage, mineral oil aided manual removal is generally recommended as first line (3). This technique, however, has complications associated with the slipperiness of lubricant use. Techniques requiring the use of screwdrivers and cutting devices to separate the plates may also increase risk of injury (3).

The lower frequency of tissue injury in our study compared to similar techniques used in other studies may be attributed to the variance in quality of wire cutters (4). During testing, it was observed that depending on how the tissue was entrapped in the zipper, one technique may

be preferable over the other in order to avoid further tissue damage for the patient. For example, if the entrapped skin precludes safe use of our proposed technique, the median bar technique would be preferred. Contrarily, if most of the entrapped skin surrounds the median bar it would be recommended to use our novel technique as it utilizes a different angle of approach. Overall, the time to completion of our novel technique was fast, with physicians completing the technique in just under 30 seconds on average.

Limitations

There were some notable limitations to this study. The wire cutters used were new and therefore sharp. Not every emergency department may have access to fresh wire cutters which could alter the applicability of results and outcome of the technique. Tissue damage was assessed by a nonblinded observer and complicated by the maceration of the chicken skin by the zipper itself. Linear lacerations were rare. However, based on the methods involved in both techniques crush injuries may have been more likely to occur rather than full-thickness lacerations. Findings from a single institution study also limit the generalizability of the study findings, as well as the simulated setting testing techniques while being timed and watched.

Conclusions

Findings from our study show that performance using our novel technique for removal of penile skin from a zipper is similar to the median bar release technique regarding time to release and tissue damage. Larger non-inferiority or equivalence simulation studies comparing this novel technique to others would be useful to support its use as another treatment option for the release of entrapped penile skin from a zipper mechanism.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

CRedit authorship contribution statement

Alex Piszker: Writing – review & editing, Writing – original draft, Methodology, Investigation, Data curation, Conceptualization. **Jennifer Goodrich:** Writing – review & editing, Writing – original draft, Conceptualization. **Tracy Koehler:** Writing – review & editing, Software, Methodology, Investigation, Formal analysis, Data curation. **Ryan Offman:** Writing – review & editing, Writing – original draft.

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Article Summary

1. Why is this topic important?

This topic is important because it describes and illustrates a novel technique to remove entrapped skin from a zipper mechanism. This is an uncommon emergency department presentation and has high potential for additional iatrogenic injury with common removal techniques.

2. What does this study attempt to show?

This study attempts to show that our novel release technique performs as well as the already-established median bar technique.

3. What are the key findings?

The key findings are that there were no significant differences in success, time to release, or tissue injury between the novel technique and the established median bar technique.

4. How is patient care impacted?

This article can improve patient care by introducing a new technique for providers to use when encountered with skin entrapped in a zipper. Given the high rates of iatrogenic injury with this presentation, knowledge of multiple release techniques can improve patient outcomes and potentially reduce iatrogenic injury.