

Comparison of Hair Knotting with Primary Suture and Stapler Techniques in Scalp Lacerations: A Prospective, Observational Study

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Abstract

Aim: We aimed to compare the primary suture and stapler techniques with the hair knotting technique in patients presenting to the emergency department with scalp lacerations and investigate their efficacy in emergency service practice.

Materials and Methods: This was a single-center prospective observational study in which patients were divided into three groups according to the treatment technique of hair knotting, stapler, and primary suture. Patients with a hair length greater than 3 cm and a linear incision less than 10 cm were included in the study. The duration of the procedures and the patients' post-treatment complications, cosmetic problems, pain scores, and satisfaction status were evaluated.

Results: A total of 120 patients were included in the study. The median length of stay in the emergency department in the hair knotting group was 23 min, which was shorter compared to the remaining stapler and primary suture ($p=0.003$ and $p=0.001$). The complication rates evaluated on days 7 and 14 were lower in the hair knotting group than in the primary suture group ($p=0.002$ and $p=0.012$, respectively). The hair knotting group also had a lower rate of cosmetic problems on days 0, 7, and 14 compared with the primary suture group ($p=0.014$, $p=0.003$, and $p=0.027$, respectively).

Conclusion: Hair knotting can be used as an alternative technique to the stapler and suture techniques in the emergency department due to its lower cost, less painful nature of the procedure, shorter stay of patients in the emergency department, and requirement of no sedation or local anesthesia.

Keywords: Scalp laceration, stapler, hair knotting, primary suture, emergency service

Introduction

Many trauma patients present to emergency services every year (1). Scalp lacerations are seen in 5% of these patients (2). The treatment of existing lacerations is traditionally performed with primary sutures, staplers, and tissue adhesives (3). Among these methods, suturing is the most commonly used laceration repair method (4), but due to its invasive nature, the procedure both takes a long time and results in pain in the patient (5). Another method used for treating scalp lacerations is the use of staplers, which is preferred in the emergency department due to its fast application. However, this procedure has certain disadvantages, such as the possibility of injury to the person applying it, and scalp punctures (6).

The ideal treatment management of a scalp laceration would be a procedure that can be applied in a short time without incurring pain and has good cosmetic outcomes and minimum complications (2). Hair knotting, first described by Applebaum et al. (7), is a technique that provides closure of the wound by knotting hair, as the name implies. With this technique, a less invasive procedure is performed on the patient in the emergency department. In addition, the hair knotting technique has lower cost. Furthermore, in the pediatric population, sedation and related side effects can be avoided and patients can leave the emergency department in a shorter time.

In this study, we aimed to compare the primary suture and stapler techniques with the hair knot technique in patients admitted



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to the emergency department with scalp lacerations and to investigate their efficacy in emergency service practice.

Materials and Methods

Study Design and Setting

This prospective observational study was conducted between March 1, 2021 and November 31, 2021 in the emergency department of a tertiary hospital. The study was initiated after receiving approval from the Atatürk University Faculty of Medicine Local Ethics Committee (number: B.30.2.ATA.0.01.00/417, date: 01.10.2020). Written informed consent was obtained from all volunteer patients participating in the study or their relatives. The study was conducted in accordance with the principles of Good Clinical Practices of the Declaration of Helsinki and the CONSORT directive.

Sample Size and Patients

The G-Power 3.1 software was used to calculate the sample size required for the study. To calculate the sample size, the medium effect size was taken as 0.5, type 1 error as 0.05, and power as 0.80. The required sample size was calculated as 40 patients for each group (120 patients with an allocation ratio of 1:1:1) at 10% loss.

Patients from all age groups with scalp lacerations were included in the study. Other inclusion criteria were having a hair length of 3 cm and above, having linear lacerations but no stellar lacerations, and having an incision length of less than 10 cm. Patients with a hair length shorter than 3 cm, those with an incision longer than 10 cm, those with active bleeding, cases in which bleeding did not stop after applying pressure for 5 min, patients with severely contaminated wounds, unconscious patients, those with unstable vital signs, and pregnant women were excluded from the study.

Randomization and Outcomes

The patients were divided into three treatment groups: hair knotting, stapler, and primary suture. The technique to be applied to the patients was randomly decided by the physician. All patients were treated by emergency medicine specialists. The primary outcomes were complications (pain, redness, hair loss, wound dehiscence, and wound drainage) and cosmetic problems that occurred after treatment. The secondary outcomes were the pain score of the patients according to the visual analog scale (VAS) administered during the procedure (10-point scale with 0 indicating no pain and 10 representing worst pain ever experienced) and the duration of the procedure.

Study Variables and Intervention

The patients' age, gender, hair color, hair length, incision length, and the type of trauma was recorded on the previously prepared forms. The treatment to be applied was decided by the physician randomly. The decided method was applied to each patient. Then, whether the patient received sedation or local anesthesia and the duration of the procedure were recorded on the same form. After the procedure, the patients' satisfaction with the procedure, whether the wound caused any cosmetic problem visually, and the pain levels during the procedure were recorded by asking the patient or his/her relatives. The patients were evaluated by the physician on days 7 and 14 after treatment in terms of wound-related complications. Satisfaction with the procedure and presence of cosmetic problems were determined by asking the patient or his/her relatives and recorded in the form. The satisfaction status and cosmetic problems were evaluated as present or absent. Cognitive sedation was given to some patients in the pediatric age group for patient comfort. The VAS scores of these patients were evaluated as 0, and their parents were asked about their satisfaction.

In the primary suture group, the wound was cleaned according to standard procedures. Local anesthesia was applied around the wound. The wound was sutured using Prolene material. After one week, the stitches were removed.

In the stapler group, the wound was cleaned. Local anesthesia or sedation was applied around the wound to only some patients who were agitated. Using a stapler, the wound lips were brought together and stapled. The stapler materials were removed after one week.

In the hair knotting group, the wound area was cleaned according to the procedures. Local anesthesia or sedation was not given to any patient. At least 10-15 strands of hair on both sides of the wound were brought together and knotted over the wound. At least three knots were tied. No tissue glue was used to prevent the knot from opening. The stitches were not removed. The patients were checked every two days to evaluate hair growth. The hair knot was not untied at each dressing. The knot was untied after wound healing.

Statistical Analysis

Statistical analysis was performed using Statistical Package for the Social Sciences software version 25.0 (IBM Corp., Armonk, New York, USA). The distribution of variables was evaluated for normality using the Kolmogorov-Smirnov test. Descriptive statistics were given as frequency (n) and percentages (%) for categorical variables. In the comparison of continuous variables with more than two independent groups, analysis of variance

(ANOVA) was used when the normal distribution condition was met and the Kruskal-Wallis test otherwise. Following the Kruskal-Wallis test, the Kruskal-Wallis one-way ANOVA (k samples) was used as a post-hoc test. In 2x2 comparisons between categorical variables, the Pearson chi-square test was used if the expected value was calculated as >5, the chi-square Yates test if 3-5, and Fisher's Exact test if <3. The statistical significance level was taken as p<0.05.

Results

Patient Population and Characteristics

A total of 120 patients (40 patients in each group) were included in the study. The median age of the patients was 24 [minimum 1-maximum (min-max) 70] years. The number of female patients was 27 (67.5%) in the hair knotting group, 14 (35.0%) in the

stapler group, and nine (22.5%) in the primary suture group. Five (12.5%) of the patients in the stapler group were sedated. The detailed demographic and characteristic features of the patients are given in Table 1.

Comparison of Groups

When the length of laceration was evaluated according to the groups, the median length of laceration was 3 cm (min-max: 2-7 cm) in the hair knotting group, 4 cm (min-max: 2-9 cm) in the stapler group, and 3.5 cm (min-max: 2-8 cm) in the primary suture group, indicating no statistically significant difference between the groups (p=0.102 for hair knotting vs. stapler, p=0.872 for hair knotting vs. primary suture, and p=0.264 for stapler vs. primary suture) (Table 2).

		The hair knotting group (n=40, 100%)	Stapler group (n=40, 100%)	The primary suture group (n=40, 100%)	Total (n=120, 100%)
Age	Median (min-max)	13 (3-36) years	28 (1-62) years	27 (2-70) years	24 (1-70) years
Gender	Female	27 (67.5%)	14 (35.0%)	9 (22.5%)	50 (41.7%)
	Male	13 (32.5%)	26 (65.0%)	31 (77.5%)	70 (58.3%)
Hair color	White	3 (7.5%)	7 (17.5%)	5 (12.5%)	15 (12.5%)
	Brown	14 (35.0%)	7 (17.5%)	6 (15.0%)	27 (22.5%)
	Blonde	4 (10.0%)	5 (12.5%)	3 (7.5%)	12 (10%)
	Black	19 (47.5%)	21 (52.5%)	26 (65.0%)	66 (55%)
Hair length	<3 cm	0 (0%)	3 (7.5%)	0 (0%)	3 (2.5%)
	3-6 cm	7 (17.5%)	12 (30%)	21 (52.5%)	40 (33.3%)
	>6 cm	33 (82.5%)	25 (62.5%)	19 (47.5%)	77 (64.2%)
The type of trauma	Beaten	3 (7.5%)	7 (17.5%)	2 (5.0%)	12 (10%)
	Fall from height	19 (47.5%)	13 (32.5%)	17 (42.5%)	49 (40.8%)
	Isolated head trauma	12 (30.0%)	15 (37.5%)	17 (42.5%)	44 (36.7%)
	Car accident	6 (15.0%)	5 (12.5%)	4 (10%)	12 (12.5%)
Sedation	Applied	0 (0%)	2 (5.0%)	5 (12.5%)	5 (4.2%)
	Not applied	40 (100%)	38 (95.0%)	35 (87.5%)	115 (95.8%)
Local anesthesia	Applied	0 (0%)	5 (12.5%)	35 (87.5%)	40 (33.3%)
	Not applied	40 (100%)	35 (87.5%)	5 (12.5%)	80 (66.7%)

min-max: Minimum-maximum

	The hair knotting group Median (min-max)	The stapler group Median (min-max)	Primary suture group Median (min-max)	p*	p1	p2	p3
Laceration length (cm)	3 (2-7)	4 (2-9)	3.5 (2-8)	0.223	0.102	0.872	0.264
The length of the stay in the emergency department (min)	23 (8-12)	35.5 (12-72)	42 (20-80)	0.001	0.003	0.001	0.129
The duration of procedure (min)	3 (2-6)	3 (1-6)	8.5 (5-16)	0.001	0.586	0.001	0.001
VAS scores	2 (1-3)	4 (0-5)	2 (0-4)	0.001	0.001	0.349	0.001

p*: Kruskal-Wallis test, p1: Hair knotting vs. stapler, p2: Hair knotting vs. primary suture, p3: Stapler vs. primary suture, min-max: Minimum-maximum, VAS: Visual analog scale

The median length of stay in the emergency department was 23 minutes (min-max: 8-12 minutes) for the hair knotting group, 35.5 minutes (min-max: 12-72 minutes) for the stapler group, and 42 minutes (min-max: 20-80 min) for the primary suture group. Accordingly, the length of stay in the emergency department was statistically significantly shorter in the hair knotting group than in both the stapler and primary suture groups ($p=0.003$ and $p=0.001$, respectively) (Table 2).

The median duration of the procedure was determined as 3 minutes (min-max: 2-6 minutes) for hair knotting, 3 min (min-max: 1-6 minutes) for the stapler application, and 8.5 min (min-max: 5-16 min) for primary suturing. While there was no statistically significant difference between the stapler and hair knotting groups in terms of the duration of procedure ($p=0.586$), a statistically significant difference was observed when these two groups were compared with the sutured group ($p=0.001$ for both) (Table 2).

The median VAS score was 2 (min-max: 1-3) in the hair knotting group, 4 (min-max: 0-5) in the stapler group, and 2 (min-max: 0-4) in the primary suture group. The VAS scores of the hair knotting and primary suture groups were lower compared with the stapler group ($p=0.001$ for both). However, the VAS score did not differ statistically between the hair knotting and primary suture groups ($p=0.349$) (Table 2).

When the groups were compared according to the complications on days 7 and 14 after treatment, the complication rate was found to be significantly lower in the hair knotting group than in the primary suture group ($p=0.002$ and $p=0.012$, respectively) (Figure 1) (Table 3).

Concerning patient satisfaction with the procedure applied, no statistically significant difference was found between the groups in terms of satisfaction evaluated on days 0, 7, or 14 ($p>0.05$) (Figure 2) (Table 3).

Table 3. Comparison of complications, patient satisfaction, and cosmetic problems between the groups

		The hair knotting group (n=40, 100%)	The stapler group (n=40, 100%)	The primary suture group (n=40, 100%)	p1*	p2*	p3*
Complications of 7 day	Pain	6 (15%)	7 (17.5%)	11 (27.5%)	0.201	0.002	0.164
	Redness	6 (15%)	11 (27.5%)	14 (35.0%)			
	Hair loss	0 (0%)	1 (2.5%)	2 (5.0%)			
	Wound dehiscence	1 (2.5%)	3 (7.5%)	2 (5.0%)			
	Serous wound drainage	0 (0%)	0 (0%)	1 (2.5%)			
	None	27 (67.5%)	18 (45.0%)	10 (25.0%)			
Complications of 14 day	Pain	1 (2.5%)	3 (7.5%)	5 (12.5%)	0.335	0.012	0.303
	Redness	2 (5.0%)	5 (12.5%)	8 (20.0%)			
	Hair loss	0 (0%)	0 (0%)	1 (2.5%)			
	Wound dehiscence	1 (2.5%)	1 (2.5%)	0 (0%)			
	Serous wound drainage	0 (0%)	0 (0%)	0 (0%)			
	None	36 (90.0%)	31 (77.5%)	26 (65.0%)			
Satisfaction status, day 0	Satisfied	35 (87.5%)	32 (80.0%)	30 (75.0%)	0.674	0.337	0.839
	Dissatisfied	5 (12.5%)	8 (20.0%)	10 (25.0%)			
Satisfaction status, day 7	Satisfied	36 (90.0%)	34 (85.0%)	33 (82.5%)	0.801	0.608	0.946
	Dissatisfied	4 (10.0%)	6 (15.0%)	7 (17.5%)			
Satisfaction status, day 14	Satisfied	38 (95.0%)	36 (90.0%)	34 (85.0%)	0.739	0.301	0.739
	Dissatisfied	2 (5.0%)	4 (10.0%)	6 (15.0%)			
Cosmetic problem, day 0	Satisfied	8 (20.0%)	15 (37.5%)	20 (50.0%)	0.222	0.014	0.461
	Dissatisfied	32 (80.0%)	25 (62.5%)	20 (50.0%)			
Cosmetic problem, day 7	Satisfied	2 (5.0%)	10 (25.0%)	14 (35.0%)	0.067	0.003	0.501
	Dissatisfied	38 (95.0%)	30 (75.0%)	26 (65.0%)			
Cosmetic problem, day 14	Satisfied	1 (2.5%)	7 (17.5%)	9 (22.5%)	0.127	0.027	0.791
	Dissatisfied	39 (97.5%)	33 (82.5%)	31 (77.5%)			

*Chi-square test.
p1: Hair knotting vs. stapler, p2: Hair knotting vs. primary suture, p3: Stapler vs. primary suture

Cosmetic problems were present in 20%, 5.0% and 2.5% of patients in the hair knotting group on days 7 and 14, respectively, whereas these rates were determined as 50%, 35% and 22.5%, respectively for the primary suture group, indicating that the hair knotting group had statistically significantly lower values in all evaluation times ($p=0.014$, $p=0.003$ and $p=0.027$, respectively) (Table 3) (Figure 3).

Discussion

In this study, we found that the hair knotting technique could be an effective alternative to the stapler and primary suture methods for treating patients with scalp lacerations who have an appropriate hair length. Hair knotting causes fewer complications and cosmetic problems than primary suturing. In the hair knotting technique, patients also feel less pain because no

invasive procedure is performed. Hair knotting can be performed in a shorter time than primary suturing; therefore, the length of stay in the emergency department is shorter for patients who have undergone hair knotting compared to the other techniques.

Hock et al. (8) evaluated the complications of hair knotting and stapler techniques in patients with scalp lacerations on the seventh day after treatment. The rate of bleeding and infection was found to be similar in both groups. Similarly, Karaduman et al. (9) stated that there was no difference between the hair knotting, stapler, and primary suture techniques in terms of complications evaluated on day 7. Ong et al. (10), on the other hand, reported fewer complications with the hair knotting group on the seventh day after treatment compared with the primary suture technique in scalp lacerations. In our study, we observed fewer complications on days 7 and 14 among the patients who underwent hair knotting compared with those who underwent primary suturing. The most common complications seen on day 7 in all groups were pain and redness. On day 14, the most common complication was redness in all groups. Serous wound drainage was in only one patient in the primary suture group.

Hock et al. (8) determined that patient satisfaction with hair knotting was higher than that with suture for treating scalp lacerations. The authors attributed this higher satisfaction rate of hair knotting to the rapid implementation of the technique, no anesthesia requirement, and stitches not being removed. Karaduman et al. (9) evaluated patient satisfaction with the hair knotting, stapler, and suture techniques used in scalp lacerations on the 30th day after treatment and reported that 97% of the patients stated that they would prefer hair knotting. In the current study, the satisfaction rate of patients who were treated with hair knotting was higher than those treated with stapler and suture techniques. The 14th-day satisfaction the patients who

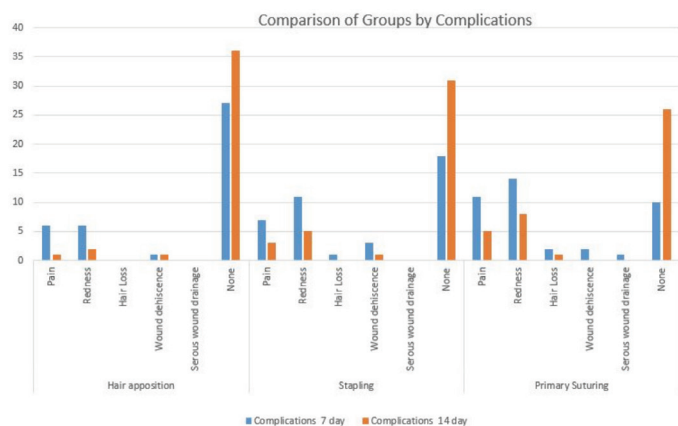


Figure 1. Comparison of the groups according to the presence of complications on days 7 and 14

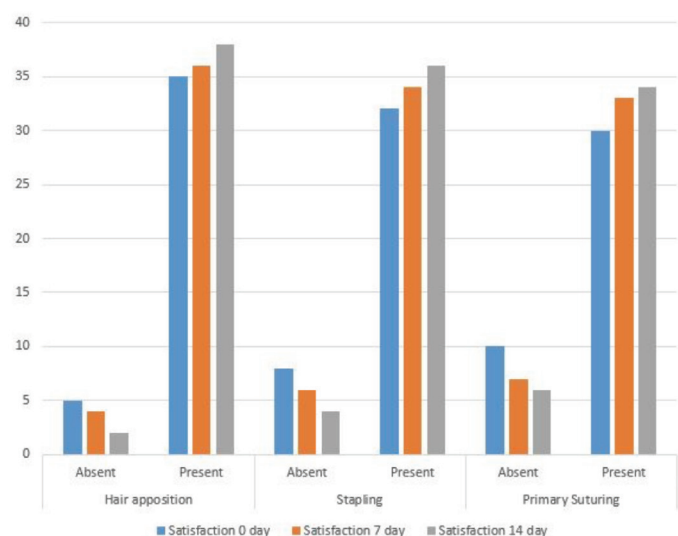


Figure 2. Comparison of the groups according to patient satisfaction on days 0, 7 and 14

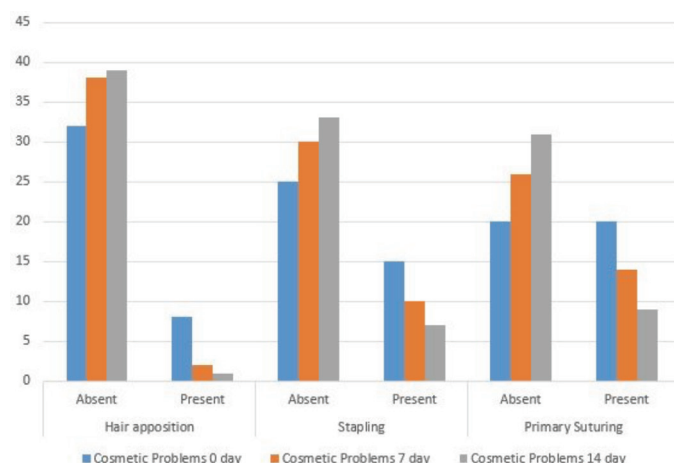


Figure 3. Comparison of the groups according to the presence of cosmetic problems on days 0, 7 and 14

underwent hair knotting treatment was 95%. However, when the groups were compared statistically, there was no significant difference. This may be due to the patients' similar response to treatment in all three groups.

Kanegaye et al. (11) evaluated the cosmetic outcomes of suture and stapler methods applied to the pediatric population with scalp lacerations on the seventh day after treatment and reported no statistically significant difference between the groups. In our study, the hair knotting group did not statistically significantly differ from the stapler group in terms of cosmetic problems evaluated on days 0, 7 and 14 of treatment; however, a significant difference was detected between the hair knotting and primary suture groups. We consider that this difference in cosmetic problems may be due to the absence of suture removal in the hair knotting technique and excessive hair loss in patients receiving primary suture treatment.

There are publications reporting that hair knotting takes a shorter time to perform than suturing and stapleing (8,9,11). There are also studies suggesting that stapler treatment in scalp lacerations is performed in a shorter time than primary suture treatment (12-15). In our study, it was determined that the hair knotting treatment had a similar duration of procedure compared to the stapler technique and took a shorter time than primary suturing. We also observed that the duration of the procedure was shorter in the stapler group than in the primary suture group. The reason why stapler treatment had a similar duration to hair knotting was that two patients in the stapler group received sedation and five patients received local anesthesia.

Because hair knotting is performed in a short time for treating scalp lacerations and requires no sedation or local anesthesia, patients' length of stay in the emergency department is shorter compared to those that have undergone suturing. This contributes to the rapid circulation of patients in emergency services.

In a previous study, comparing the pain levels of patients who underwent hair knotting and primary suturing treatments for scalp lacerations, it was determined that the VAS score of the patients in the hair knotting group was 2, indicating less pain compared to the primary suture technique (8). In the current study, the VAS score of the patients who underwent hair knotting was similar to those who underwent primary suture treatment but lower than those who received stapler treatment. In the primary suture group, sedation or local anesthesia was applied to the patients before the procedure. In our study, the VAS score of the sedated patients was evaluated as "0" (no pain). This explains why there was no significant difference in the pain levels of the patients in the primary suture and hair knotting groups.

Study Limitations

Patients with short hair or no hair not being included in the appropriate patient profile for hair knotting is among the limitations of this study. In addition, the treatment methods to be applied to the patients were randomly selected by the physicians. Finally, the sedation procedure was performed in some patients, and the VAS pain scores of these patients were accepted as 0. The reason for not excluding patients who underwent sedation from the study was to more clearly determine the length of stay in the emergency department and the duration of procedures.

Conclusion

Hair knotting is a technique that can be used as an alternative to primary suture and stapler treatments in emergency services. The advantages of the hair knotting technique over the other two techniques include the less painful nature of the procedure, shorter length of stay in the emergency department, requirement of no sedation or interventional procedure, and lower costs.

Ethics

Ethics Committee Approval: The study was initiated after receiving approval from the Atatürk University Faculty of Medicine Local Ethics Committee (number: B.30.2.ATA.0.01.00/417, date: 01.10.2020).

Informed Consent: Written informed consent was obtained from all volunteer patients participating in the study or their relatives.

Peer-review: Externally and internally peer-reviewed.

Authorship Contributions

Surgical and Medical Practices: A.G., E.T., İ.Ö., E.Y.Ç., Concept: A.G., İ.Ö., E.Y.Ç., Design: A.G., İ.Ö., Data Collection or Processing: A.G., E.T., F.T., Analysis or Interpretation: A.G., F.T., Literature Search: A.G., E.T., E.Y.Ç., Writing: A.G., F.T.

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