

Is Shaving Hair Necessary in Cranial Surgery?*

Czy w chirurgii czaszki konieczne jest zgolenie włosów?

Serpil Yüksel¹, Meryem Kubaş², Neriman Akyolcu³, Sebahat Durdu²

¹University of Abant İzzet Baysal, Bolu Health School, Department of Surgical Nursing

²University of İstanbul Faculty of Medicine, Department of Neurosurgery

³University of İstanbul, Florence Nightingale Faculty of Nursing, Department of Surgical Nursing

Abstract

Shaving the hair before cranial surgery is a common application with the purpose of preventing surgical site infections. However, shaving the hair particularly in women and young patients causes the impairment of the body image and negatively affects the rehabilitation process. In the studies evaluating the wound infections in patients that shaved or unshaved before craniotomy, it has been shown that the infection rate in shaved patients was 1.22 – 8% and 0 – 13.6% in unshaved patients. It was stated in the studies that scalp shaving was not effective in the prevention of surgical site infections, and cranial surgeries can be made safely without shaving scalp with the provision that proper skin preparation is made. In this review, whether or not the scalp shaving is effective in the prevention of surgical site infections and the proper hair and skin preparation before the surgical intervention will be discussed. (PNN 2013;2(2):83-89)

Key words: cranial surgery, infection, scalp flora, skin preparation solutions, shaving hair

Streszczenie

W chirurgii czaszki, w celu zapobieżenia zakażeniu miejsca operacyjnego (ZMO) przed przystąpieniem do kraniotomii, często stosowanym zabiegiem jest częściowe lub całkowite zgolenie włosów na głowie. Jednakże szczególnie w przypadku kobiet i pacjentów młodych zgolenie włosów powoduje niekorzystne zmiany wyglądu zewnętrznego i ma negatywny wpływ na proces rehabilitacji. Wyniki badań przypadków zakażenia ran operacyjnych u chorych, u których przed zabiegiem kraniotomii zgolono włosy oraz u tych, których włosów nie zgolono wskazują, że stopień występowania zakażeń w przypadku zgolenia włosów wynosił 1,22 – 8%, a w przypadku niezgolenia włosów 0 – 13,6%. W wyniku przeprowadzonych badań stwierdzono, że zgolenie włosów nie ma wpływu na zapobieżenie ZMO, a w przypadku poprawnego przygotowania skóry zabieg kraniotomii może być bezpiecznie wykonany bez zgolenia włosów. W niniejszym opracowaniu przedyskutowany zostanie temat golenia włosów przed zabiegiem chirurgicznym oraz wpływ lub brak wpływu tej czynności na zapobieganie ZMO, a także jak należy przygotować przed zabiegiem włosy i skórę u pacjentów, u których włosów nie zgolono.

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Słowa kluczowe: chirurgia czaszki, zakażenie, flora skóry głowy, roztwory do przygotowania skóry, zgolenie włosów

Introduction

Shaving all or part of hair before cranial surgeries is a widely adopted procedure. Shaving hair is performed in order to prevent potential surgical site infections (SSI) after cranial surgery, facilitate cleaning and marking of the surgical site, insure easier incision and

better view of the incision line, and ease closing of the scalp and application of bandages or dressing following cranial surgery [1-10].

Shaving hair prior to cranial surgeries was first utilized in 1886 by Gustav Neuber, a German surgeon, and the procedure was later adopted by other surgeons, such as Sir Victor Horsley and Harvey Cushing [11].

Removing hair from the surgical site before surgical interventions was not supported by neurosurgeons alone, but almost by every surgeon because it is thought that presence of hair on the surgical site increases the risk of infections [3,4,12]. Neurosurgeons believe hair to be unclean, harboring bacteria, and that it increases the risk of infection by contaminating the surgical site. Therefore, through long ages, shaving scalp hair has been considered a compulsory preparation to be performed prior to cranial surgery [1,6,11,13]. However, it is known that shaving hair leads to epidermal injuries by causing minor traumas on the scalp, damages hair follicles, and increases pathogenic growth by disrupting the flora, thus accelerating colonization and increasing the risk of wound infection [2-4,7,8,10,14,15]. Moreover, hair follicle openings, the area between the body of the hair and superficial stratum corneum, is the area in which bacterial density is high, and shaving exposes high numbers of hair follicles, increasing the risk of contamination of the wound by bacteria [16,17]. In a study aimed to determine the effects of various scalp hair-shaving techniques on development of infection, the infection ratio was determined to be 2.9% in patients shaved using the standard wet shaving technique, while it was 5.5% in patients shaved using the dry shaving technique (3.2% using manual razors and 2.8% using electric razors), though it was reported that there was no significant difference between both techniques in terms of infection [18].

Hair is a cosmetic value effective in social communication settings and social identity, and it is one of the most important molders of physical appearance. Loss of hair might decrease quality of life by causing diminished sense of self and physical appearance. Especially in women and young patients, shaving part or all of hair leads to physiological stress and distorted body image, and delays in getting back to daily life, particularly professional life, thus negatively affecting the rehabilitation period [1,6,10-12,19]. Studies have shown that young women fear shaving of hair due to stigmatization [20], problems regarding social integration and rehabilitation may arise, particularly in children [6], people with certain occupations, in which personal appearance is important, are uncomfortable with shaving of hair, and that these patients fear going back to work with surgical incisions and receiving negative responses from their bosses or customers [21]. Ratanalert and Sriplung [11] determined that 60% of patients who were undergoing cranial surgeries preferred shaving of hair because they believed it was clean and comfortable, that the ratio of patients who accepted shaving after being informed that it has no effects on the outcome of the surgical intervention decreased to 48%, and that the ratio of those who agreed on surgery without shaving increased from 12% to 37%. It was also determined in the same study that individuals

with high educational levels, women, and those who frequently take part in social activities did not want shaving [11].

Studies have revealed that patients who undergo cranial surgeries without shaving of hair are content with protecting their hair, that they do not experience distorted body image, their hospitalization periods are shorter, and that they are able to go back to their private lives and jobs much sooner without experiencing any psychological problems or changes in body image [1,4,6,21]. Miller et al. [5] suggested that shaving hair should be avoided in cranial procedures in order to improve patients' self respect and insure their safety. Therefore, the issue of whether shaving hair is a compulsory preparation before cranial surgeries or not should be clarified, and patients should not be forced to unwillingly accept shaving of their scalp hair.

Does shaving hair prior to cranial surgery prevent surgical site infection? The answer to this question is crucial, because infection may delay wound healing, prolong hospitalization, increase costs, lead to further surgical interventions, and increase morbidity and mortality rates.

The second important question that needs to be answered is "When, how, and with what should skin preparation be performed in cranial surgery patients whose hair is not shaved?" It was indicated in a study that cranial surgery, in which scalp hygiene is established without shaving the hair, is practical and safe [15].

In this review, answers to the abovementioned questions were discussed in light of 16 English and Turkish studies published between the years 1992 and 2012, and of which full texts could be obtained by searching electronic databases using the keywords "Unshaved cranial surgery", "Infection rate after unshaved cranial surgery", and "Unshaved skin preparation".

Does Shaving Hair Prevent Surgical Site Infections?

The main underlying reason for shaving hair prior to cranial surgeries is to prevent SSI. Therefore, unshaved cranial surgery is not a widely accepted practice, because it is proposed that the remaining hair inside the wound may pose a risk of infection, and hair may interrupt the surgical intervention, prolonging its duration, particularly the duration required to close the wound [1,7,19].

Ratanalert et al. [1] indicated that surgical interventions in unshaved patients lasted longer than in those who were shaved (240 ± 115 and 160 ± 74 , respectively). However, in the same study, patients were not shaved right before, but on the morning of the sur-

gical interventions at the clinic, and thus, shaving duration was not included in calculating the total time of the surgical intervention itself. Kretschmer et al. [20] also reported that closing the skin took 20 minutes longer in unshaved patients than in shaved patients. In another study, in which patients were shaved in the operating room right before the surgical intervention, the claimed duration of closing the skin that was longer in unshaved patients was shorter than the time needed for the shaving process itself [13]. In a randomized, controlled study (RCS) by Horgan et al. [22], there was no significant difference between shaved and unshaved patients in terms of the duration of surgical preparation and skin closing. Miyagi et al. [14] also indicated that not shaving the scalp hair is safer in implant surgery, and that shaving is complicated and takes time.

There are studies showing that shaving hair does not prevent SSI, and that safe cranial surgeries can be performed with proper skin preparation without shaving hair. The findings of these studies revealed that shaving hair was ineffective in preventing infection, and that infection rates were similar between shaved and unshaved patients [1,4-6,14,22].

Evaluating the studies that assessed development of infection in shaved and unshaved patients revealed that the infection rate in shaved patients was 1.22 – 8% [1,4-6,14,22], and 0 – 13.6% in unshaved patients (Table 1) [1-7,13-15,19-24]. Ratanalert et al. [1] indicated that hair was not the cause of infection, but it was the long waiting period before the surgical intervention, and the hot and humid climate.

When the study results presented in Table 1 are examined, the difference between developed infection rates in shaved and unshaved patients draws attention, though similar results in both shaved and unshaved groups in studies that reported high infection rates should also be noted. In another study conducted with a single group of unshaved patients, and reported high infection rates (13.6%), it was indicated that swab cultures were obtained from patients prior to surgical interventions, and that there was no correlation between positive cultures and SSI, and hair length [15].

In multiple studies, the bacteria responsible for the infections that developed in shaved and unshaved patients was determined to be *Staphylococcus aureus* (*S. Aureus*) [1,13,14,15]. Other bacteria responsible for the development of infection following surgical interventions were determined to be *Methicillin-resistant staphylococcus aureus* (MRSA) [4,7], *Enterobacter*, *Escherichia coli*, *Acinetobacter* and *Staphylococcus epidermidis* (*S. Epidermidis*), and *Coagulase negative staphylococci* (*CoNS*) [4,15]. Considering that hair harbors *S. Aureus*, that the scalp has a complex microbial flora [15], and that 90% of it consists of *CoNS* [16], despite the studies showing that there was no correlation between the number of bacteria on the skin [16]

and culture/swab results, and infection [6,15], these findings propose the idea that skin preparation is important before cranial surgery. Winston et al. [13] indicated that when the surgical site is properly cleaned, wound sepsis would rarely be observed even if there were hair inside the incision.

How Should the Hair and Skin Be Prepared in Unshaved Cranial Surgery Patients?

The hair and haired skin should be effectively cleaned in order to perform unshaved cranial surgery [13], because hair and haired skin harbor pathogenic bacteria. The scalp normally has a complex polymicrobial flora consisting of *Diphtheroids*, *Staphylococci* (*CoNS*, *S. Epidermidis* and *S. Aureus*), other *gram-positive cocci, bacilli, and fungi* [15,16,25]. The diversity of the flora might vary depending on personal hygiene and setting (home, hospital, etc.) [15]. Therefore, even though hair were to be shaved, the scalp cannot be cleansed of permanent pathogens, because bacteria that are in the creases of the skin cannot be cleansed with cleaning solutions, and there may still be enough left to pose a risk of infection [6,16]. It is known that completely removing the permanent flora on skin surface with surgical skin preparation is impossible, and that only 20% of it can be destroyed. However, surface flora is important since it is the determinant of the deeper flora that increases the risk of SSI [15,16,26].

There are different practices for when, how, and with what to prepare the hair and skin in unshaved cranial surgery patients. Studies in which chlorhexidine, betadine/iodophor/povidone iodine, cetrimide, and isopropanol were used as cleaning solutions, it has been determined that there were differences between the solutions in terms of dosage, and application time and frequency. Hair and skin preparation practices found in obtained studies are summarized in Table 1.

In studies where the hair was washed with chlorhexidine shampoo (4%) prior to surgical intervention, and surgical site was scrubbed using povidone iodine (10%) [3], iodophor [22], and chlorhexidine (4%; 50:50 diluted) [21], infection development was not observed. In two similar studies where chlorhexidine shampoo was used prior to surgical intervention, the infection rate was determined to be 1.1% in the study where the surgical site was scrubbed for at least 8 minutes with chlorhexidine solution (4%) [13], and the it was 1.25% where the surgical site was scrubbed twice using povidone iodine (10%)/chlorhexidine (4%) solution [4]. In another study where no preparation was performed prior to surgical intervention, the hair was washed with chlorhexidine solution (4%), and the surgical site was scrubbed using chlorhexidine solution (0.05%), the infection rate was determined to

be 1.1% [7]. On contrary to the results of these studies, in two other studies where the hair was washed with shampoo prior to surgical intervention, the infection rate was determined to be 3.37% in the study where the surgical site was painted with chlorhexidine and scrubbed with chlorhexidine soap for 5 minutes [1], while it was determined to be 1.1% in the study where the surgical site was brushed using chlorhexidine-alcohol solution (0.5%) and the incision area was washed with saline at the completion of each surgical step [19].

In two studies where the surgical site was scrubbed using diluted isopropanol solution following a wash with shampoo prior to surgical interventions, the infection rate was 0% in the study where cleaning was performed for 10 minutes [23], and it was 0.5% in the other study where cleaning was performed for 5 minutes [20].

In the study where, following skin preparation with povidone iodine (1%) in the operating room, cleaning was performed using chlorhexidine (0.015%), cetrimide (0.15%), and povidone iodine again (1%), the infection rate was determined to be 0.095% [2]. In another study where, following shampooing in the morning prior to surgical intervention, the infection rate was determined to be 7% among patients whose surgical sites were scrubbed with povidone iodine (10%) [5]. In a different study, in which povidone iodine was used to wash the hair and prepare the surgical site, the infection rate was determined as 0.05% [14]. In the study with the highest infection rate (13.6%) among all studies that were obtained in this literature review, patients' hairs were washed with shampoo both on the previous night and on the morning of the surgical interventions, and surgical site was scrubbed using povidone iodine (7.5%) soap and povidone iodine (10%) solution [15].

All the abovementioned studies show that there is no protocol on how to prepare the hair and skin in unshaved cranial surgeries, and that there are different practices on the solution to be used, and duration or time of application. In three [3,21,22] of the studies in which no infection was observed in any of the patients [3,21-23], the common practice was washing the hair with chlorhexidine shampoo before the surgical intervention. The infection rate was between 1.1% and 1.25% in other studies in which chlorhexidine was used [1,4,7,13,19], while it was between 0.05% and 13.6% in studies where povidone iodine was used [2,5,14,15]. Studies in which isopropanol solution was applied [20,23], it was indicated that no infection was observed in studies where application duration was long. These data suggest that preparations using chlorhexidine and isopropanol are more effective than using normal shampoo and povidone iodine.

In a randomized study comparing the effects of antiseptics, reported results of post-op near-wound scalp cultures from cranial surgery patients, on which chlorhexidine shampooing was performed, showed that the bacteria growth was significantly lower when shampooing was performed with chlorhexidine (4%) prior to surgical interventions compared to iodophor (7.5%) or no shampooing. These results were indicated to be due to the residual activity of chlorhexidine lasting longer than iodophor, especially with repeated uses [16]. In a similar study by Güzel et al. [26], it was determined that there was no *S. Aureus* growth following a three-minute skin cleansing with chlorhexidine solution (15%), that there was no growth of microorganisms in any of the skin cultures after two applications of 30-second cleaning using povidone iodine (10%) following chlorhexidine, and that the use of chlorhexidine and povidone iodine solutions was safe and effective for skin antisepsis [26]. However, Sukul et al. [27] indicated that chlorhexidine is a neurotoxin, which may have long-term negative effects through its absorption by the neural tissue, and therefore, it is not safe to use chlorhexidine in neurosurgery patients.

The complicated results mentioned above suggest that the question of how skin preparation should be performed in neurosurgery remains a current topic of discussion.

Conclusion

Studies have revealed that the practice of shaving hair has no effects on the success of cranial surgeries, on the contrary, it is a practice prolonging the duration for patients before going back to their daily lives, and distorting body image, and that hair does not pose an extra risk of infection. However, accurate information could not be obtained from any of the reviewed studies on when and how to prepare the hair and skin, using which solution for how long, and how to determine the concentration of solutions being used in unshaved patients. Additionally, only one RCS was found in the literature comparing skin preparation duration, incision closing duration, and infection rate in shaved and unshaved patients, and no RCS were found investigating the correlation between skin preparation and SSI in unshaved patients. Therefore, a well-designed RCS with a big sample size can be recommended in order for unshaved cranial surgeries to become more widely adopted.

* This study was presented as an oral presentation at 6th National Congress of Neurosurgical Nursing, May 14-18, 2010, Antalya, Turkey.

Table 1. Studies Results of Wound Infection Rates, Skin and Hair Preparation on Shaved and Unshaved Cranial Surgery Patients

Two groups studies with unshaved and shaved patients			
Research	Sample and design	Infection rate	Preparation of skin and hair
Ratanalert et al. 1999	Prospective, non-randomized controlled study. Unshaved group: 89 cranial procedures Shaved group: 136 cranial procedures Follow-up: 6 months	Unshaved group: 3.37% (3/89) Shaved group: 5.88% (8/136) (p>0.05).	Unshaved group: <i>Preoperative:</i> The hair was washed with shampoo. <i>Intraoperative:</i> The surgical site was scrubbed for 5 minutes with chlorhexidine soap solution. Shaved group: The surgical site was scrubbed with povidone-iodine soap.
Horgan et al. 1999	Randomized controlled study. Unshaved group: 20 patients Shaved group: 10 patients Follow-up: 10 months	There was no infection recorded in two group.	Unshaved group: <i>Preoperative:</i> The hair was washed with chlorhexidine (4%) soap solution. <i>Intraoperative:</i> Scalp, hair and surgical site was scrubbed with an iodophor detergent scrub solution.
Tang et al. 2001	Prospective, non-randomized controlled study. Unshaved group: 35 patients Shaved group: 65 patients Follow-up: 6 months	Overall infection rate was 0.3%. Unshaved group: 7.1% (1/14) Shaved group: 8% (2/25) (p>0.05).	Unshaved group: <i>Preoperative:</i> The hair was washed with shampoo that had been diluted betadine solution. <i>Intraoperative:</i> The surgical site was scrubbed with betadine or betadine plus chlorhexidine in all patients.
Miller et al. 2001	Retrospective study. Unshaved group: 1050 patients Shaved group: 100 patients Follow-up: 3 months	Unshaved group: 7% (11/150) Shaved group: 6% (6/100) (p>0.05).	Unshaved group: <i>Intraoperative:</i> The surgical site was shampooed and cleaned twice with povidone-iodine solution (10%). Shaved group: <i>Intraoperative:</i> The surgical site was painted with 7.5% povidone-iodine scrub followed by povidone-iodine (10%) solution in all patients.
Bekar et al. 2001	Prospective, non-randomized controlled study Unshaved group: 1038 patients Shaved group: 980 patients Follow-up: Three or four weekly intervals to monitor wound healing.	Unshaved group: 1.25% (13/1038) Shaved group: 1.22% (12/980) (p>0.05).	Unshaved group: <i>Preoperative:</i> All patients had a full-body bath with chlorhexidine (4%) shampoo. <i>Intraoperative:</i> The hair on the surgery site was cleaned twice with povidone-iodine (10%) before surgery by using a soft brush for 8-10 minutes and the hair was again washed with povidone-iodine solution after surgery. Later in the study, chlorhexidine was used instead of iodine.
Miyagi et al. 2002	Retrospective study. Unshaved group: 199 implantations Shaved group: 62 implantations Follow-up: 3 months	Unshaved group: 0.5% (1/199) Shaved group: 1.6% (1/62) (p>0.05).	Unshaved group: <i>Preoperative:</i> The hair was scrubbed with povidone-iodine soap. <i>Intraoperative:</i> The surgical site was scrubbed with povidone-iodine solution
Single group studies with unshaved patients			
Winston 1992	Prospective study. 638 neurosurgical procedures with unshaved patients. Follow-up: 40 months	Overall infection rate was 1.1% (7/638).	<i>Preoperative:</i> All patients had a bath with chlorhexidine (4%) shampoo. <i>Intraoperative:</i> The surgical site was scrubbed for at least 8 minutes with undiluted 4% chlorhexidine and then irrigated with 70% isopropyl alcohol.

Table 1.

Research	Sample and design	Infection rate	Preparation of skin and hair
Korfali et al. 1994	Prospective study. 142 patients with unshaved cranial procedures Follow-up: each day during the first week and later weekly	No infections was recorded in the study population.	<i>Preoperative:</i> The hair was washed with chlorhexidine (4%). <i>Intraoperative:</i> The hair on the surgery site was cleaned with povidone-iodine (10%) before surgery by using a soft brush for 8-10 minutes and then the hair was washed with bacitracine solution.
Braun and Richter 1995	Prospective study. 57 patients with unshaved cranial procedures Follow-up: Unspecified	No infections was recorded in the study population.	<i>Preoperative:</i> The hair was washed with shampoo. <i>Intraoperative:</i> The hair was scrubbed for 10 minutes with undiluted isopropanol solution.
Siddique et al. 1998	Retrospective study. 105 patients with unshaved cranial procedures Follow-up: Unspecified	Infection rate was 0.95% (1/105).	<i>Intraoperative:</i> The hair was cleaned with tincture of iodine (1%), 10 minutes later, the surgical site was washed with chlorhexidine (0.015%) and cetrimide (0.15%).
Sheinberg and Ross 1999	Prospective study. 346 cranial surgeries with unshaved. Follow-up: 3 to 4 week	No infections was recorded in the study population.	<i>Preoperative:</i> The hair was washed with chlorhexidine shampoo. <i>Intraoperative:</i> The hair was scrubbed for 10 minutes with %4 chlorhexidine diluted 50:50 with water and then rinsed with isopropyl alcohol.
Kretschmer et al. 2000	Prospective study 215 cranial surgeries with unshaved. Follow-up: Unspecified	Infection rate was 0.5% (1/215).	<i>Preoperative:</i> The hair was washed with shampoo. <i>Intraoperative:</i> The hair was scrubbed for 5 minutes using an undyed isopropanol solution and the hair was fixed chlorhexidine jelly (20%).
Gil et al. 2003	Retrospective study 175 skull base operations with nonshaved. Follow-up: 45 months	Infection rate was 1.1% (2/175).	<i>Intraoperative:</i> The hair was washed with chlorhexidine (4%) and surgical site was scrubbed with chlorhexidine (0.05%) solution.
Adeleye and Olowokere 2008	Prospective study 17 unshaved cranial surgeries Follow-up: 2-6 months	There was no infection.	<i>Intraoperative:</i> The surgical site was scrubbed with initial soapy lotions and then povidone iodine.
Tokimura et al. 2009	Retrospective study. 632 patients who underwent cranial surgeries with unshaved. Follow-up: 2-4 weeks	Infection rate was 1.1% (7/632).	<i>Preoperative:</i> The hair was washed with shampoo. <i>Intraoperative:</i> The surgical site was brushed with 0.5% chlorhexidine-alcohol solution and irrigated with saline at the completion of each surgical step.
Moiyadi et al. 2012	Prospective study. 44 patients who underwent cranial surgeries with unshaved. Follow-up: 1 month	Infection rate was 13.6% (6/44)	<i>Preoperative:</i> The hair was washed with shampoo. <i>Intraoperative:</i> The surgical site was prepared with a povidone-iodine (7.5%) soap-based surgical scrub and painted with povidone-iodine (10%) aqueous solution.

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Corresponding Author:

Serpil Yüksel
University of Abant İzzet Baysal, Bolu Health School, Department of Surgical Nursing
Gölköy Kampüsü. 14280 Merkez/Bolu
e-mail:yukselserpil1977@gmail.com

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