

Comparison of the antiseptic effects of Betadine and Sterillium on microbial load of surgical hands

Ahmad Entezari¹, Mohammad Hossein Avazbakhsh¹, Hamid Mirhosseini², Razieh Ghasemi³, Elahe Fatahi Bafghi³

1. Instructor, Department of Anesthesia and Operation Room, School of Paramedical Sciences, Shahid Sadoughi University of Medical Sciences, Yazd, Iran

2. Assistant Professor, Department of Anesthesia and Operation Room, School of Paramedical Sciences, Shahid Sadoughi University of Medical Sciences, Yazd, Iran

3. BSc in Surgical Technologist, Shahid Sadoughi University of Medical Sciences, Yazd, Iran

*Correspondence: Hamid Mirhosseini, School of Paramedical Sciences, Shahid Sadoughi University of Medical Sciences, Yazd, Iran.
Email: Mirhosseini@ssu.ac.ir

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ABSTRACT

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Background: Hand washing is an essential measure in controlling the infection in the operating room, the correct implementation of which requires time. Therefore, the use of fast-acting and safe disinfectant is of great importance in this regard. Regarding this, the present study aimed to compare the antiseptic effects of Betadine and Sterillium on the microbial load of the surgical hands.

Methods: This quasi-experimental study was conducted on 93 operating room staff working at teaching hospitals of Yazd, Iran, in 2013, using random sampling method. Hand washing was first performed uniformly using 5 ml of non-antibacterial soap for 1 min. Subsequently, the hand washing was performed on two separate occasions with an interval of one week with 12 ml of Betadine and Sterillium for 3 min according to the the instructions of each solution. The sampling was carried out immediately after hand washing. In order to evaluate the lasting effects of the disinfectants, another sampling was also performed after the surgery. The data were analyzed using the Chi-square test, independent t-test, and repeated measures ANOVA through the SPSS version 17.

Results: The mean difference of the microbial load of the hands washed with Betadine was 15.97 ± 3.08 CFU/ml, which decreased to -0.64 ± 0.28 CFU/ml ($P=0.012$) at the post-intervention stage. Regarding the Sterillium, the mean microbial loads of the hands were 16.73 ± 3.0 and -0.032 ± 0.64 CFU/ml at the pre- and post-intervention stages, respectively ($P=0.037$). This difference between the two solutions was significant ($P=0.04$).

Conclusion: The findings of the present study revealed that the Sterillium was more fast-acting than the Betadine. However, Betadine showed more lasting effect as compared to the Sterillium. Therefore, it is suggested to choose the disinfectant with regard to the onset and duration of the surgery.

1. Introduction

Today, nosocomial infection is the problem of the health care systems in different countries.^{1, 2} According to the Center of Disease Control and Prevention, about 1.8 million people are annually at the risk of hospital-acquired infections, and 20,000 individuals die because of direct contact with these infections.³ The hospital-acquired infections are mostly transmitted through hand contact of hospital personnel and other people that are in contact with or take care of the patient.⁴ Lack of attention to this important issue in the operating room and special wards of the hospital increases the mortality rate and the risk of infection distribution to the society.

Therefore, the use of new detergents and optimizing the hand washing procedure by the healthcare personnel is of paramount importance.^{5, 6}

The aim of hand washing with antiseptics is to remove the transient microorganisms and reduce their permanent presence. In order to perform the invasive (e.g., surgery) and non-invasive treatment measures, the surgical and medical hand washing are executed, respectively.⁷

The products used to disinfect the hands before the surgery should have broad antimicrobial power and fast-acting effect. In addition, these products should have durable effects to prevent from the microorganism growth as well as skin irritation and sensitization during the surgery.^{8, 9} Therefore, the

selection of a suitable antiseptic, which results in less skin damage and stronger and preferably more stable antimicrobial effect, is of fundamental importance.

The Betadine scrub has been conventionally used in Iran for many years. Betadine (povidone iodine) is a traditional antiseptic, consisting of iodine and polymers as carrier. This solution applies its decontamination effect by gradual release of inorganic iodine on the skin and mucous membrane. Iodine has a bactericidal effect on the gram-positive and gram-negative bacteria, acting against fungi, viruses, parasites, cysts, protozoa, yeasts, and spores.^{10, 11} However, the long-term use of antiseptics, such as Betadine, which requires scrubbing with brush, can damage the skin after a while and be associated with increased colonization of gram-negative bacteria and candida species.¹² In this regard, Madani and Farahmandi (2003) proposed the shortening of the scrubbing time as a method of decreasing the skin damage.⁴ The reduction of the Betadine scrubbing time from 10 to 5 min has been a standard for many years. Meanwhile, in the European countries, the alcoholic antiseptics with fast-acting antimicrobial activity are more preferred and used.¹³⁻¹⁵

Sterillium is one of the most commonly used alcoholic solutions, containing 45% 2-propanol, 30% 1-propanol, 0.2% mecetronium ethylsulfate. This product eliminates the microbes caused by sweating and protects the skin in case of surgical glove tear.¹⁶

Several studies have indicated that 2-to-3-minute Betadine scrubbing is as effective as the 5-minute scrubbing. However, the use of alcoholic solutions, such as Sterillium, reduced this time to 1.5 min.^{4, 12} Some studies, including a research by Sayedolshohadaei *et al.* (2008), recommended to replace the Betadine by alcoholic solution of Sterillium in the intensive care units.¹⁷ Shir Yazdi *et al.* (2014) also pointed out the equal quick effect of Betadine and Sterillium solutions.¹⁸ However, the aforementioned studies just evaluated and compared the fast-acting effects of Betadine and Sterillium; however, the sustainability of the antiseptic effect is another important issue. With this background in mind, this study aimed to compare the antiseptic effects of Betadine and Sterillium on the microbial load of the surgical hands.

2. Methods

2.1. Design

This quasi-experimental study was conducted on the members of the surgical teams, including surgeons and operating room technicians of Shahid

Sadoughi and Shahid Rahnemoun hospitals, affiliated to the Shahid Sadoughi University of Medical Sciences, Yazd, Iran, in 2012. It should be mentioned that the surgical teams of both hospitals were similar.

2.2. Participants and setting

The sample size was estimated to be 93 cases with regard to the similar studies^{4, 6} and the number of eligible subjects. The participants were selected from the members of the general surgery, gynecology, and ophthalmology surgical teams using simple random sampling technique. To do so, first, three operating rooms were randomly selected from each hospital. Subsequently, the participants were recruited using purposive and convenience sampling techniques.

The inclusion criteria were: 1) no use of any anti-bacterial products (e.g., ointment, cream, soap, and shampoo) and systemic antibiotics one week before and during the study (to protect skin flora), 2) having healthy skin without a scratch, 3) short nails, 4) lack of nail polish, and 5) no allergy to antiseptics. It should be mentioned that in order to control the time effect of different surgeries, we included the employees, who had the time interval of three hours between their hand washing and the end of the surgery.

The only exclusion criteria was the occurrence of any skin sensitivity during the study.

2.3. Instruments

The study instruments were a demographic form and a researcher-made checklist. The demographic form included the age, gender, educational level, work experience, type of operating room, and length of surgery. The checklist was prepared to record the results of the microbial culture of the samples taken from the participants' hands before and after scrubbing (i.e., once after Betadine scrubbing and once after Sterillium scrubbing with the time interval of one week) as well as after surgery.

In addition, we used an electronic incubator (Fater Inc., Iran) calibrated with a standard mercury thermometer, swap, Stewart's medium (Iran), eosin methylene blue (EMB) medium agar, blood agar (Darvash Co., Iran), and colony counting device (Colony Count, Germany). The validity of the colony counting device was confirmed through calibrating the device by the medical engineer of the hospital.

Moreover, the reliability of this device was confirmed using the test-retest method. To do so, 10 samples of the microbial cultures were counted by the device every 5 min for three times. Based on the calculation of the correlation coefficient between the

numbers of the estimated colonies, the reliability of the device was estimated to be 95%.

2.4. Data Collection

Prior to the study, a briefing meeting was held by the researcher for all the participants and supervisors to explain about the study objectives and train the proper way of hand washing and scrubbing with Betadine and Sterillium at the educational conference hall of the hospital. These trainings were based on the protocol proposed by the World Health Organization and the special protocol of hand washing with alcohol-based solutions.¹⁹⁻²¹ However, the researcher directly observed the method of hand washing applied by the participants during the study.

To evaluate the impact and sustainability of the assessed solutions, three rounds of sampling were performed by the researcher. The samples were obtained from the wrinkles of both palms and under the nails using sterile swaps. The first round of sampling was performed after washing hands with non-antibacterial soaps and water. The second sampling was performed after hand washing with Betadine/Sterillium, and the third one was conducted at the end of the surgery.

Following the ethical principles, the participants were required to wash their hands for 1 min with 5 ml of liquid non-antibacterial soap and dry them with paper towels. Afterwards, the researcher collected the samples from the wrinkles of both palms and under the nails using sterile swaps. In the next stage, the hands were scrubbed with Betadine for 3 min (for three times, 1 min per each washing, using 4 ml of Betadine). To this aim, after wetting the hands, they were brushed from the fingertips to 5 cm above the wrists. After rinsing the hands and drying them with a clean towel, the samples were collected. In order to assess the sustainability of the Betadine impact, another sampling was performed from the hands of the participants one more time post-surgery.

After one week, the participants were required to wash their hands for 1 min with 5 ml of liquid non-antibacterial soap, and then rinse and dry them. The samples were taken from under the nails and wrinkles of the palms. Subsequently, the hands were washed with alcoholic solutions for 3 min using 12 ml of Sterillium, without rinsing, and the second samples were collected after drying the hands. Another sampling was performed following the surgery.

To culture the samples, the samples were placed on sterile plates containing EMB medium and blood agar in an isolated manner. The samples were kept at 37 °C in the incubator for 24 h. In order to detect

the microbial load of the grown colonies, we performed such tests as oxidase (with disk), catalase (on glass slides using oxygenated water on the colonies acquired from EMB), and coagulase (gram-negative or gram-positive) using the gram staining. The number of bacteria was estimated using the colony counting device based on the number of colonies per ml. This process was performed for all the samples.

2.5. Ethical considerations

In order to comply with the research ethics, the research objectives were explained to the participants individually and in groups, and they were assured of the confidentiality terms regarding their personal information. In addition, the subjects were ensured that the participation was completely voluntarily, and withdrawal from the study had no effect on their evaluation process. Moreover, the researcher was available throughout the study, and the written informed consents were obtained from the participants prior to the study.

2.6. Statistical analysis

The data analysis was performed in the SPSS version 17 using the descriptive statistics (mean and standard deviation), paired t-test (to compare the mean microbial loads before and after using Sterillium and Betadine), independent t-test (to compare the mean difference of the microbial load of the hands between the two solutions) and repeated measures ANOVA (to evaluate the mean of the microbial load of the hands before the use of solutions with that of post-surgery).

3. Results

The demographic characteristics of the participants are provided in Table 1. The samples collected from the hands washed with Betadine and Sterillium had positive and negative cultures. Immediately after washing the hands with Betadine, 28% of the cultures were reported to be negative, which reached to 93.5% following the surgery. Furthermore, immediately after washing the hands with Sterillium, 35.5% of the cultures were negative, which amounted to 90.3% after the surgery (Diagram 1). According to the results of the independent t-test, the mean difference of the two antiseptics obtained after the surgery was significant ($P=0.04$).

In addition, the results of the repeated measures ANOVA were indicative of declined number of bacteria in both Betadine and Sterillium methods. The results of the Fisher's LSD post hoc test demonstrated a significant difference between the

changes in the microbial load of the hands before and after the use of Betadine ($P=0.013$). Likewise, the microbial load estimated immediately after the Betadine application was significantly different,

compared to that of the post-surgery ($P=0.04$). Moreover, this test indicated that the microbial load was only significant in the time interval of before and after the use of Sterillium ($P=0.028$).

Table 1. Demographic characteristics of the participants

Variables		N(%)
Gender	Male	38(40.9)
	Female	55(59.1)
Educational level	Associate degree	10(10.7)
	Bachelor's degree	45(48.4)
	Specialist	38(40.9)
Type of operating room	Ophthalmology	27(29)
	General surgery	29(31.2)
	Gynecology	37(39.8)
Work experience (year)	<15	75(80.6)
	>15	18(19.4)
Surgery duration (hour)	<1	49(52.7)
	1-2	28(30.1)
	>2	16(17.2)

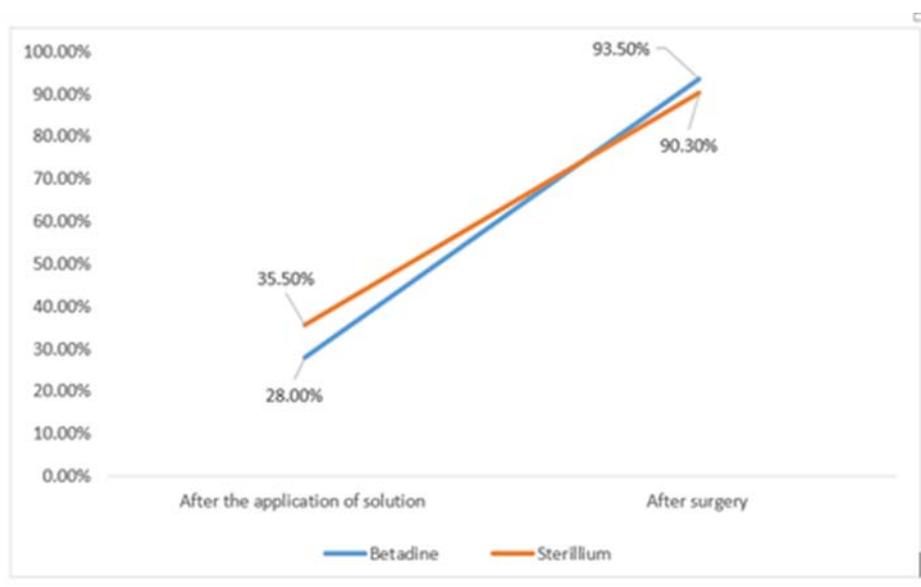


Diagram 1. Comparison of culture results before and after the intervention

Table 2. Comparison of mean differences in microbial load of hands using Betadine and Sterillium

Time	Solution	Betadine	Sterillium	*P-value
		M±SD	M±SD	
Before the application of solution		15.97±3.08	16.73±3.0	0.73
After the application of solution		-0.21±0.59	-0.019±1.4	0.54
After surgery		-0.64±0.28	-0.032±0.64	0.04
**P-value		0.012	0.037	

*Independent t-test; **Repeated measures ANOVA

4. Discussion

According to the results of the present study, Sterillium had a higher fast-acting antiseptic effect, compared to Betadine.

On the other hand, the effect of Betadine was more susceptible. Our findings are in line with the results obtained by Zandieh and Roshanaei (2015)

in terms of the fast-acting effects of alcohol-based solutions.¹⁶ Sharifi and Samadi Aydanlo (2008) also reported that despite the five-fold increase of scrubbing duration with Betadine, the alcoholic solutions had higher antimicrobial effects.²² Therefore, it can be concluded that the factor of washing duration had no significant impact on the effectiveness of solutions.

In a review study conducted by Fadime *et al.* (2016), most of the retrieved articles reported that Sterillium have more fact-acting effects, compared to Betadine.²³ However, some contradictory results reported in the mentioned study might be due to the differences in washing methods and the size of study population. Bryce *et al.* (2001) demonstrated no significant difference in the microbial counts of hands after using alcohol-based solutions and conventional antiseptics, such as Betadine. Nevertheless, the microbial counting of hands 2 h after washing was at a more acceptable level in the alcohol-based solution group, compared to the other groups.²⁴ This lack of consistency between these results and our findings might be due to adding chlorhexidine solution to Betadine in the study carried out by Bryce *et al.*, causing reduced effectiveness of the compound.

Inconsistent with the results of the current study, Sayedolshohadaei *et al.* (2008) reported that the microorganism reduction was higher in the Betadine group, compared to the Strillium group after using these antiseptics.¹⁷ Since this study was conducted in the Intensive Care Unit (ICU), this discrepancy can be ascribed to the fact that the microorganisms presented in the ICU are different from those in the operating room. Additionally, the results obtained by Marchetti *et al.* (2003) confirmed these findings.²⁵ These researchers believed that while the surgical antiseptic products might show similar effects during testing, it is possible that they act significantly different in various settings. There are also many contradictions regarding the sustainability of the antiseptic skin solution effect, which might be indicative of the lack of using a standard and similar washing technique, diversity of manufacturers of these solutions, sampling method (especially attention to the level of dryness of hands upon sampling), as well as the health and cultural conditions of different communities.

In a study carried out by Winnefeld *et al.* (2000), it was demonstrated that disinfecting the hands with alcoholic solutions led to the better removal of temporary skin contamination. They suggested that since alcohol causes less skin damage, compared to the other antiseptics, it should be considered in the hospital settings for daily use.²⁶ Similarly, in the present study, there were no complaints of skin complications with regard to the availability of samples. Noroozinia *et al.* (2012) demonstrated that there was a significant difference between the effects of Betadine and Sterillium on the reduction of the microorganism growth of the surgical team members' hands and skin complications. As a result, they recommended

Sterillium as a proper choice in situations when the time of starting the surgery is a vital issue.²⁷ In line with our results, Kampf *et al.* (2005) also expressed that 1.5 min of scrubbing with Sterillium for a three-hour surgery led to decreased bacterial density in the participants.²⁸ Therefore, it seems that the effectiveness of antiseptics increases with time.

One of the major drawbacks of this study was the lack of participation of all the personnel of different operating rooms. However, the researcher tried to persuade the hospital staff to participate by explaining about the importance of the evaluated issue.

5. Conclusion

According to the findings of the present study, both of the antiseptics (*i.e.*, Betadine and Sterillium) investigated in this study were effective in the reduction of the microbial load of the hands. Furthermore, the Sterillium scrubbing was found to have some privileges over Betadine, such as the lack of need to rinse and reduced time of scrubbing. Regarding this, Sterillium can be replaced by Betadine, especially when the time to start the surgery is vitally important.

Conflicts of interest

The authors declare no conflicts of interest.

Authors' contributions

Ahmad Entezari: design, implementation of the project, participation in data analysis
 Mohammad Hossein Avazbakhsh: implementation of the project, participation in data collection, preparation of the initial version,
 Hamid Mirhosseini: design and guiding of the project, participation in data analysis, preparation of the final version,
 Razieh Ghasemi: participation in data collection and preparation of the basic version of the article,
 Elahe Fatahi Bafghi: participation in data collection and preparation of the final version.

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References

1. Khodadad A, Lamea L, Shakiba M. The prevalence of careers and microbial spectrum of healthcare worker's hand and relation between detergent used for washing. *Tehran University Medical Journal* 2005; 62(4): 291-302. [Persian]
2. Weinstein RA. *Infection control in the hospital*. 15th ed, Braunwald E, Fauci AS, Kasper LH, editors. Philadelphia: Mc Graw Hill. 2001; 1-6.
3. Boyce JM, Pittet D. Centers for Disease Control and Prevention. Guideline for hand hygiene in health-care setting. *Morbidity and Mortality Weekly Report*. 2002; 51(PR-16):1-44.
4. Madani A, Farahmandi AR. Study of time necessary for preoperative scrubbing of the hand. *Razi Journal of Medical Sciences* 2003; 10(34): 297-302. [Persian]
5. Mojtahedi A, Khoshrang H, Taromsari MR, KazemnezhadLeili E, Hoorvash E. Bacterial contamination of health care worker's hands in intensive care units in Rasht. *Journal of Nosocomial Infection* 2014; 1(1): 36-43. [Persian]
6. Horng LM, Unicomb L, Alam MU, Halder AK, Shoab AK, Ghosh PK, et al. Healthcare worker and family caregiver hand hygiene in Bangladeshi healthcare facilities: results from the Bangladesh national hygiene baseline survey. *Journal of Hospital Infection* 2016; 94(3): 286-94.
7. Widmer AF, Rotter M, Voss A, Nthumba P, Allegranzi B, Boyce J, et al. Surgical hand preparation: state-of-the-art. *Journal of Hospital Infection* 2010; 74(2): 112-22.
8. Fortunato N. *Berry & Kohn's Operating Room Technique*. 9th ed. St. Louis: Mosby; 2000; 21-39.
9. Chauveaux D. Preventing surgical-site infections: measures other than antibiotics. *Orthopaedics & Traumatology: Surgery & Research* 2015; 101(1): 77-83.
10. Dokoohaki R. A comparison of the efficacy of the use of povidone iodine and 70% ethyl alcohol for sterilization of the skin before venipuncture in the obstetrics and surgical units of Faghihi hospital, Shiraz. *Journal of Shahid Sadoughi University of Medical Sciences and Health Services* 2003; 11(3): 46-9. [Persian]
11. Tanner J, Dumville JC, Norman G, Fortnam M. Surgical hand antisepsis to reduce surgical site infection. *The Cochrane Database of Systematic Reviews* 2016; 1(1):1-10.
12. Hsieh HF, Chiu HH, Lee FP. Surgical hand scrub in relation to microbial count: systematic literature review. *Australian Journal of Advance Nursing* 2006; 55(1):68-78.
13. Twomey C. *Hand Hygiene, Best practice*. 2006 [May 2006]; TCT-Main Articles]. Available from: WWW.infectioncontrolday.com.
14. Betadine surgical scrub complications. 2004; Available from: www.netdoctor.com.uk/medicine.
15. Kampf G, Kramer A. Epidemiology background of hand hygiene and evaluation of most important agents for scrubs and rubs. *Clinical Microbiology Reviews* 2004; 17(4): 863-93.
16. Zandiyeh M, Roshanaei G. Effectiveness of three surgical alcohol-based hands rubs on skin flora. *Iranian Journal of Nursing and Midwifery Research* 2015; 20(2): 221-5.
17. Sayedolshohadaei S, Khairollahi S, Afkhamzadeh A. Comparison of efficacy of hand washing with Betadin and Sterillium on bacterial colony count in intensive care unit personnel. *Scientific Journal of Kurdistan Univesity of Medical Sciences* 2009; 13(4): 1-8. [Persian]
18. Shiryazdi SM, Aboueiian M, Mollahoseini F, Amrollahi KH, Paydar H, Barzegar Bafroey H. A comparison of betadine, sterillium and silver nanocolloid immediate effect on surgical hand antiseptic. *Iranian Journal of Medical Microbiology* 2014; 8(2): 35-40. [Persian]
19. Kampf G, Ostermeyer C. World health organization-recommended hand-rub formulations do not meet european efficacy requirements for surgical hand disinfection in five minutes. *Journal of Hospital Infection* 2011;78(2): 123-7.
20. Pittet D, Allegranzi B, Boyce J. The world health organization guidelines on hand hygiene in health care and their consensus recommendations. *Infection Control & Hospital Epidemiology* 2009; 30(7): 611-22.
21. Zandiyeh M, Roshanaei GH. Comparison of disinfectant effect of decosept and betadine-ethanol on hand bacterial flora. *Medical -Surgical Nursing Journal* 2014; 3(3): 142-8. [Persian]
22. Sharifi N, Samadi Aydanlo N. Comparison of decosept disinfection effect with povidon-iodine on hand skin normal flora. *Journal of Urmia Nursing And Midwifery Faculty* 2008; 6(3):121-6. [Persian]
23. Fadime G, Hergül FK, Özbayir T. Surgical hand washing: a systematic review *International Journal of Antisepsis Disinfection Sterilization* 2016; 1(1): 23-32.
24. Bryce EA, Spence D, Roberts FJ. An in-use evaluation of an alcohol-based pre-surgical hand disinfectant. *Infection Control Hospital Epidemiology Journal* 2001; 22(10): 635-9.
25. Marchetti MG, Kampf G, Finzi G, Salvatorelli G. Evaluation of the bactericidal effect of five products for surgical hand disinfection according to prEN 12054 and prEN 12791. *Journal of Hospital Infection* 2003; 54(1): 63-7.
26. Winnefeld M, Richard MA, Drancourt M, Grob JJ. Skin tolerance and effectiveness of two hand decontamination procedures in everyday hospital use. *British Journal of Dermatology* 2000; 143(3): 546-50.
27. Noroozinia H, Mahoori A, Hassani E, Behmagham E. Comparison of surgical hand scrub with povidone -iodine, decoseptand sterillium. *Urmia Medical Journal* 2012; 23(4): 446-50. [Persian]
28. Kampf G, Ostermeyer C, HeegP. Surgical hand disinfection with a propanol-based hand rub: equivalence of shorter application times. *Journal of Hospital Infection* 2005; 59(4): 304-10.

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