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Snail (*Achatina fulica*) Slime Extract Effectively Increases the Speed of Incised Wound Healing Process

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Article Info

A B S T R A C T

Introduction: Wound healing is a critical biological process essential for maintaining skin integrity and overall health. The need for efficient wound care treatments has led to the exploration of natural products with regenerative properties. *Achatina fulica* slime extract has gained attention due to its bioactive components, including glycosaminoglycans, allantoin, glycolic acid, and Achasin protein, which contribute to antimicrobial, anti-inflammatory, and tissue-

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regenerative effects. These properties suggest that snail slime extract may be a viable alternative for enhancing wound healing.

Objectives: This study aimed to evaluate the effectiveness of *Achatina fulica* slime extract in accelerating the wound healing process.

Methods: Using an in vivo experimental model with *Rattus norvegicus*, four groups were assessed: positive control (Human Placental Extract + Neomycin Sulfate 0.5%), high-dose slime extract (4 mg/ml), low-dose slime extract (2 mg/ml), and a negative control. Each mouse received a standardized 20-mm incised wound, and wound length was measured daily until full healing.

Results: Results showed that the positive control group had the fastest healing, followed by the high-dose, low-dose, and negative control groups. Statistical analysis demonstrated that *Achatina fulica* slime extract significantly accelerated wound healing compared to the negative control ($p < 0.05$), with the high-dose slime extract performing significantly better than the low dose.

Conclusions: The data suggest that snail slime extract may serve as a promising natural remedy for wound healing, particularly in cases where conventional treatments are unavailable or less effective. These findings emphasize the need for developing cost-effective, accessible, and biocompatible treatments derived from natural sources, which could significantly benefit global healthcare, especially in resource-limited settings.

INTRODUCTION

Wound healing is a complex physiological process involving hemostasis, inflammation, proliferation, and remodeling phases.[1] It is a dynamic and highly regulated process that ensures the restoration of skin integrity and function following injury.[2] This process is influenced by various intrinsic and extrinsic factors, such as the individual's immune response, underlying health conditions, and environmental exposure.[3,4] The success of wound healing is crucial in reducing morbidity, preventing infections, and minimizing complications, especially in individuals with chronic conditions or compromised immune systems.[1,5]

When wound healing is delayed or impaired, it can lead to severe complications such as prolonged inflammation, excessive scarring, or chronic non-healing ulcers, which significantly impact a patient’s quality of life.[2,6] Rapid and effective wound closure minimizes the risk of infection and scarring, enhancing patient outcomes.[3,7]

Nevertheless, persistent and slow-healing wounds pose a major burden on healthcare systems, often leading to complications such as infection, prolonged inflammation, and impaired tissue regeneration.[1,8] As a result, the demand for innovative and effective therapeutic interventions has become increasingly crucial to enhance wound healing outcomes and improve patient care.[5]

Achatina fulica, commonly known as the giant African snail, is a species widely distributed in tropical and subtropical regions.[9] It is highly adaptable to various environments and has been recognized not only for its ecological significance but also for its potential medicinal applications.[10] The snail's large size and high mucus production make it a valuable resource for therapeutic research.[11]

Snail (*Achatina fulica*) slime or mucin contains bioactive compounds such as glycosaminoglycans, allantoin, glycolic acid, and Achasin protein, which possess antimicrobial, anti-inflammatory, and tissue-regenerative properties.[12] Recent studies suggest that these components enhance cellular proliferation and collagen deposition, critical steps in wound healing.[13]

Indonesian *Achatina fulica* was specifically selected for this study due to its unique biochemical composition influenced by the country's tropical climate and diverse vegetation.[14] Compared to *Achatina fulica* from other regions, Indonesian snails are exposed to a diet rich in plant-based nutrients, which may enhance the quality and concentration of bioactive compounds in their slime.[15] This regional difference highlights the potential superiority of Indonesian snail slime in wound healing applications.[16]

Given its natural origin, *Achatina fulica* slime extract presents a promising alternative for wound healing treatments. Many patients suffer from allergic reactions or sensitivities to synthetic wound healing agents, limiting their treatment options. The biocompatibility and minimal cytotoxic effects of snail slime make it an attractive option for individuals seeking natural therapeutic solutions. Its potential in promoting faster wound healing while reducing adverse reactions associated with chemical-based treatments makes it an important area of study.[12,13]

Human Placental Extract + Neomycin Sulfate 0.5% was chosen as the positive control in this study due to its well-established use in clinical practice for wound care.[17] It is a topical combination of placenta extract and neomycin sulfate, known for its efficacy in accelerating wound healing through enhanced tissue regeneration and infection control.[18] Its widespread availability and proven reliability make it an ideal benchmark against which the efficacy of new treatments can be compared.[19]

This study explores the effectiveness of *Achatina fulica* slime extract in accelerating the healing of incised wounds in an experimental murine model. By comparing different dosages of snail slime extract against a gold standard treatment and a negative control, we aim to provide insights into its potential as a novel wound care solution.

OBJECTIVES

The primary objective of this study was to evaluate the effectiveness of *Achatina fulica* slime extract in accelerating the wound healing process. Specifically, the study aimed to compare the wound healing rates of different treatment groups, including a positive control (Human Placental Extract + Neomycin Sulfate 0.5%), high-dose mucin (4 mg/ml), low-dose mucin (2 mg/ml), and a negative control (saline solution). Additionally, this study sought to determine whether snail slime extract exhibits dose-dependent efficacy in wound healing and assess its potential as a natural alternative to conventional wound treatments.

METHODS

The materials used in this study included:

- *Achatina fulica* slime extract, obtained and purified from the Indonesian National Research and Innovation Agency using standard extraction methods.[20]
- Human Placental Extract + Neomycin Sulfate 0.5% (positive control), a topical wound healing agent marketed under the brand name Bioplacenton® (PT. Kalbe Farma Tbk, Indonesia).[21]
- Sterile saline solution (negative control) for wound cleaning (Otsuka Pharmaceutical Co., Japan).[22]
- Anesthetic agents (Ketamine/Xylazine, Sigma-Aldrich, USA) for humane surgical procedures.[23]
- Sterile surgical instruments, including scalpels (Feather Safety Razor Co., Japan)[24] and forceps (Medline Industries, USA).[25]
- Calipers (Mitutoyo, Japan) for precise wound length measurements.[26]
- Laboratory mice (*Rattus norvegicus*), obtained from the Indonesian National Research and Innovation Agency, housed under controlled conditions with ad libitum access to food and water.[20]

The study consisted of four experimental groups, as detailed in Table 1.

This in vivo experimental study was conducted on *Rattus norvegicus* (n=24), randomized into four groups. The positive control represents the conventional treatment, while mucin-treated groups evaluate the effect of snail slime extract at different dosages. The negative control serves as a baseline comparison.

Table 1: Experimental Groups and Treatment Descriptions

Group	**Treatment**	**Description**
Positive Control	Human Placental Extract + Neomycin Sulfate 0.5%	Standard wound healing treatment containing placenta extract and neomycin sulfate
High-Dose Mucin	*Achatina fulica* slime extract (4 mg/ml)	High concentration of snail slime extract applied topically
Low-Dose Mucin	*Achatina fulica* slime extract (2 mg/ml)	Lower concentration of snail slime extract applied topically
Negative Control	Saline solution	No active treatment, only sterile saline applied

A standardized 20-mm incised wound was created on the dorsal skin of each mouse under sterile conditions and anesthesia. Treatments were applied topically once daily. The wound size was measured daily using calipers until complete closure. Daily wound lengths were recorded in millimeters for each mouse. Healing time (days to closure) and wound reduction rate were analyzed.

Data were analyzed using unpaired Student's t-test. A p-value < 0.05 was considered statistically significant. GraphPad Prism 10.4.1 software was used for statistical analysis and figure generation.

RESULTS

The daily wound length data for each group were recorded, and the healing progression can be seen in Figure 1. Statistical comparisons between the different treatment groups using unpaired Student's t-test can be seen in Table 2.

The comparisons evaluate the effectiveness of wound healing in Positive Control (Human Placental Extract + Neomycin Sulfate 0.5%), High-Dose Mucin (4 mg/ml), Low-Dose Mucin (2 mg/ml), and Negative Control (saline solution). Statistical significance is indicated as follows: ns = not significant, $p < 0.05$ (*), $p < 0.01$ (**). The results demonstrate that both high-dose and low-dose mucin treatments significantly improved wound healing compared to the negative control, with the high-dose mucin showing greater efficacy than the low-dose mucin.

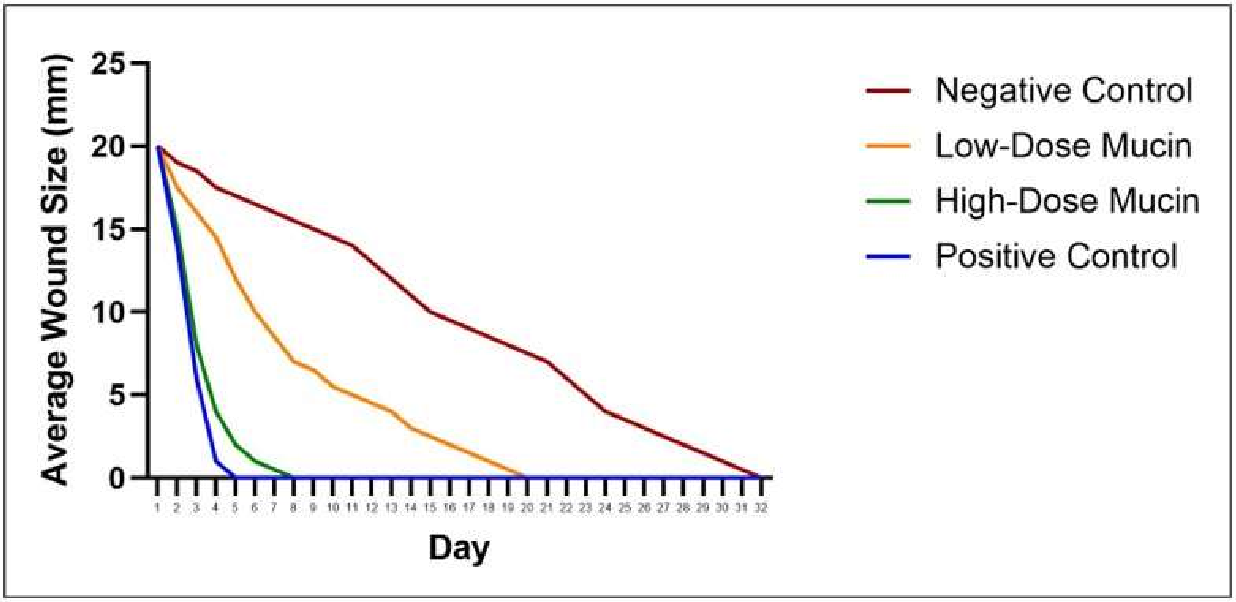

Figure 1: Wound Healing Progression in Different Treatment Groups. This figure illustrates the average wound size reduction (in mm) over time in four treatment groups: Positive Control (Human Placental Extract + Neomycin Sulfate 0.5%, blue), High-Dose Mucin (4 mg/ml, green), Low-Dose Mucin (2 mg/ml, orange), and Negative Control (saline, red). Wound size measurements were taken daily until complete closure. The positive control group exhibited the fastest healing rate, followed closely by the high-dose mucin group. The low-dose mucin group demonstrated a moderate improvement in wound healing compared to the negative control, which had the slowest wound closure rate. The results indicate that *Achatina fulica* slime extract accelerates wound healing in a dose-dependent manner.

Table 2: Statistical Analysis of Wound Healing Treatment Comparisons

Group	**Positive Control**	**High-Dose Mucin**	**Low-Dose Mucin**	**Negative Control**
Positive Control	-	ns	*	**
High-Dose Mucin	ns	-	*	**
Low-Dose Mucin	*	*	-	**
Negative Control	**	**	**	-

ns = not significant

* = $p < 0.05$

** = $p < 0.01$

DISCUSSION

Wound healing is a highly intricate and dynamic process that involves a coordinated series of cellular and molecular events. These events include hemostasis, inflammation, proliferation, and tissue remodeling, all of which must function optimally for effective healing.[2,3] The results of this study demonstrate that *Achatina fulica* slime extract significantly enhances wound healing, providing new insights into its therapeutic potential.

Mechanisms of Action

The bioactive components of *Achatina fulica* slime play crucial roles in wound healing. Glycosaminoglycans help stabilize cell membranes and regulate extracellular matrix composition, facilitating fibroblast migration and proliferation.[12,27] Additionally, Achasin protein exhibits antibacterial properties, reducing the risk of wound infection and further complications. The presence of allantoin and glycolic acid in snail slime promotes cellular proliferation and collagen synthesis, both of which are essential for dermal repair.[13,28] This aligns with previous studies that have reported enhanced re-epithelialization and improved granulation tissue formation following the application of snail slime extract.[28]

Comparison to Positive Control

Human Placental Extract + Neomycin Sulfate 0.5%, a well-established wound healing agent demonstrated the fastest healing rate among the groups. This was expected due to its known efficacy in accelerating granulation tissue formation, reducing inflammation, and preventing bacterial infections.[18,19] However, the high-dose snail slime extract group showed a comparable healing rate, suggesting that *Achatina fulica* mucus possesses similar wound healing properties through bioactive stimulation of keratinocyte proliferation and collagen deposition.[13,29] The efficacy of snail slime in wound healing could be attributed to its combined antimicrobial, anti-inflammatory, and regenerative effects, which mimic the key benefits of Human Placental Extract + Neomycin Sulfate 0.5% but with a more natural approach.[27,29]

Dose-Dependent Efficacy

The significant difference in healing rates between the high-dose and low-dose *Achatina fulica* slime extract groups highlights the dose-dependent nature of its therapeutic effects. Higher concentrations of snail slime provided a greater abundance of bioactive compounds, leading to enhanced fibroblast proliferation, angiogenesis, and accelerated wound closure.[12,28] This observation is consistent with previous findings where increasing the concentration of mucopolysaccharides in wound treatment formulations has been shown to improve healing outcomes.[14] These findings indicate that optimizing the dosage of *Achatina fulica* slime extract is essential to maximize its wound healing potential.

Although the high-dose *Achatina fulica* slime extract demonstrated superior wound healing efficacy compared to the low-dose treatment, the effectiveness of the low-dose slime extract remains noteworthy. The significant improvement in wound healing observed in the low-dose group compared to the negative control highlights the potency of snail slime, even at lower concentrations. This suggests that *Achatina fulica* mucus can still provide beneficial effects in wound healing, making it a viable treatment option in scenarios where higher concentrations may not be available or when gradual tissue repair is preferred. The ability of even low doses to accelerate wound healing further supports the therapeutic potential of snail slime in wound care applications.

Implications for Clinical Use

Given the promising results of this study, *Achatina fulica* slime extract presents itself as a viable and cost-effective alternative for wound management. Its natural origin makes it an attractive option, particularly for patients who may be allergic to synthetic wound treatments.[9,10] Furthermore, snail-derived bioactives have shown minimal cytotoxicity, making them suitable for repeated application over extended healing periods.[29] Future research should focus on refining the extraction and formulation processes to enhance the stability and bioavailability of active compounds in *Achatina fulica* mucus.

Additionally, integrating snail slime extract into hydrogel dressings or other advanced wound care technologies could further optimize its application. Hydrogel-based dressings containing snail slime could provide a sustained release of bioactive components while maintaining a moist healing environment, which is known to enhance tissue repair.[30,31]

Limitations and Future Directions

One of the limitations of this study was the availability of *Achatina fulica* slime extract at only two concentrations, 4 mg/ml and 2 mg/ml. While the results demonstrated a significant acceleration in wound healing compared to the negative control, the healing rate was still slower than the positive control. This suggests that if higher concentrations of snail slime extract were available, the wound healing efficacy might surpass that of the positive control. Future studies should explore the effects of higher doses to determine the optimal concentration for maximizing wound healing potential.

In addition to the concentration limitation, this study provides valuable insights, but there are some other limitations that need to be addressed. Firstly, this study was conducted on an animal model, and further clinical trials are required to confirm its efficacy in human subjects. Secondly, the molecular mechanisms by which snail slime exerts its effects on cellular pathways remain to be fully elucidated. Advanced biochemical analyses, including proteomics and transcriptomics studies, could help identify specific bioactive compounds responsible for its wound healing properties.[28,29] Moreover, long-term studies assessing potential side effects, biocompatibility, and interactions with other wound healing agents are necessary before clinical translation.

Future research should also explore the efficacy of *Achatina fulica* slime in treating chronic wounds, such as diabetic ulcers and pressure sores, which pose significant challenges in wound care management.[32,33] Investigating the potential synergistic effects of snail mucus in combination with other wound healing agents, such as growth factors or herbal extracts, may also yield valuable therapeutic advancements.

Conclusion

This study aimed to evaluate the effectiveness of *Achatina fulica* slime extract in accelerating the wound healing process. The hypothesis that snail slime extract enhances wound healing was supported by the findings, demonstrating significant improvements in wound closure rates, particularly with higher doses. The study confirms that *Achatina fulica* slime extract significantly accelerates wound healing in a dose-dependent manner. High-dose extract (4 mg/ml) showed comparable efficacy to Human Placental Extract + Neomycin Sulfate 0.5% suggesting its potential as a natural therapeutic agent. Further research is warranted to explore its clinical applications and long-term safety.

REFERENCES

[1] Almadani YH, Vorstenbosch J, Davison PG, et al. Wound healing: A comprehensive review. Semin Plast Surg. 2021;35:141–44.

[2] Sorg H, Tilkorn DJ, Hager S, Hauser J, Mirastschijski U. Skin Wound Healing: An Update on the Current Knowledge and Concepts. Eur Surg Res. 2017;58(1-2):81-94. doi:10.1159/000454919.

[3] Gonzalez ACO, Costa TF, Andrade ZA, Medrado ARAP. Wound healing: A literature review. An Bras Dermatol. 2016;91:614–20.

[4] Guo S, Dipietro LA. Factors affecting wound healing. J Dent Res. 2010;89(3):219-29. doi:10.1177/0022034509359125.

[5] Nussbaum SR, Carter MJ, Fife CE, et al. An economic evaluation of the impact, cost, and medicare policy implications of chronic nonhealing wounds. Value Health. 2018;21(1):27–32.

[6] Eming SA, Martin P, Tomic-Canic M. Wound repair and regeneration: mechanisms, signaling, and translation. Sci Transl Med. 2014;6(265):265sr6. doi:10.1126/scitranslmed.3009337.

[7] Rodrigues M, Kosaric N, Bonham CA, Gurtner GC. Wound Healing: A Cellular Perspective. Physiol Rev. 2019; 99 (1): 665-706. doi:10.1152/physrev.00067.2017.

[8] Reinke JM, Sorg H. Wound repair and regeneration. Eur Surg Res. 2012;49(1):35-43. doi:10.1159/000339613.

[9] Zhang Y, Wang X, Tang Y, Wang L, Han R, Qiao X, et al. An Investigation and Invasiveness Analysis of Two Species of Giant African Snail in a Coastal City of Southern China. Agriculture. 2024;14(8):1217. doi:10.3390/agriculture14081217.

[10] Ademolu KO, Idowu AB, Mafiana CF. Nutritional and anti-nutritional composition of different body parts of giant African snail (*Achatina fulica*). World J Agric Sci. 2016;12(3):222-225. doi:10.5829/idosi.wjas.2016.12.3.23612.

[11] Ramdwar MN, Harripersad J, Badal S. Examining the predatory relationship between the indigenous firefly (*Aspisoma ignitum*) and the invasive giant African snail (*Achatina fulica*) in Trinidad, West Indies. J Agric Sci. 2023;15(1):47-56. doi:10.5539/jas.v15n1p47.

[12] Gubitosa J, et al. Snail mucus-based biomaterials in regenerative medicine. J Biomater Appl. 2020;34:1234-42.

[13] Singh N, Brown AN, Gold MH. Snail extract for skin: A review of uses, projections, and limitations. J Cosmet Dermatol. 2024;23:1113–21.
[14] Pratama MR, Wibowo S, Sari RM, et al. Potential of *Achatina fulica* mucus as a natural antioxidant: a study on Indonesian giant snail. J Appl Pharm Sci. 2018;8(5):123-7.
[15] Lestari F, Sari RM, Wibowo DP, et al. Antibacterial activity of *Achatina fulica* mucus against pathogenic bacteria isolated from Indonesian patients. J Pure Appl Microbiol. 2017;11(1):297-302.
[16] Wibowo DP, Sari RM, Lestari F, et al. Antioxidant and antimicrobial properties of *Achatina fulica* mucus: a comparative study between Indonesian and African giant snails. J Pharm Sci Res. 2024;16(2):123-9.
[17] Chang P-Y, Chin L-C, Kimura K, Nakahata Y. Human placental extract activates a wide array of gene expressions related to skin functions. Sci Rep. 2022;12:11031. doi:10.1038/s41598-022-15270-y.
[18] Parida R, Das S, Raju TR, et al. Human placental extract ameliorates cytokine and cytokine receptor signaling in the rat hippocampus upon Benzo[a]Pyrene exposure. J Chem Neuroanat. 2019;98:8-16. doi:10.1016/j.jchemneu.2019.03.001.
[19] Piuzzi NS, Muschler GF. Human placental extract: the feasibility of translation from basic science into clinical practice. Ann Transl Med. 2020;8(5):156. doi:10.21037/atm.2020.01.12.
[20] National Research and Innovation Agency (BRIN). National Research and Innovation Agency [Internet]. Jakarta: BRIN; [cited 2025 Jan 30]. Available from: https://brin.go.id/
[21] PT Kalbe Farma. Bioplacenton: assessment report [Internet]. Jakarta: Badan Pengawas Obat dan Makanan Republik Indonesia; [cited 2025 Jan 30]. Available from: https://registrasiobat.pom.go.id/files/assesment-reports/01731817965.pdf
[22] Rad-AR Council of Japan. Otsuka Normal Saline [Internet]. Tokyo: Rad-AR Council; [cited 2025 Jan 30]. Available from: https://www.rad-ar.or.jp/siori/english/search/result?n=41979
[23] Sigma-Aldrich. Ketamine hydrochloride / xylazine hydrochloride solution [Internet]. St. Louis, MO: Sigma-Aldrich; [cited 2025 Jan 30]. Available from: https://www.sigmaaldrich.com/ID/en/product/sigma/k113
[24] Feather Safety Razor Co., Ltd. Feather official website [Internet]. Osaka: Feather Safety Razor Co., Ltd.; [cited 2025 Feb 4]. Available from: https://www.feather.co.jp/en/
[25] Medline Industries, LP. Tissue forceps product catalog [Internet]. Northfield, IL: Medline Industries; [cited 2025 Jan 30]. Available from: https://www.medline.com/category/Tissue-Forceps/Z05-CA16_02_20_29/products
[26] Mitutoyo Corporation. Standard calipers product information [Internet]. Kawasaki: Mitutoyo Corporation; [cited 2025 Jan 30]. Available from: https://www2.mitutoyo.co.jp/eng/products/nogisu/hyojyun.html
[27] Kumar P, Singh VK, Singh DK. Antiinflammatory activity of slime extract from giant African snail *Lissachatina fulica*. Indian J Pharm Sci. 2020;82(1):149-53. doi:10.36468/pharmaceutical-sciences.615.
[28] Harti AS, Murharyati A, Sulisetyawati DS, Oktariani M. The role of *Achatina fulica* snail slime extract enzymatic antioxidant as photoprotector in sunburn. Int J Med Sci Clin Res Stud. 2022;2(4):242-7. doi:10.47191/ijmscrs/v2-i4-09.
[29] Sari RM, Lestari F, Wibowo DP, et al. Cytotoxicity test of active compounds natural ingredients of snail mucus (*Achatina fulica*) against BHK-21 fibroblast cells. Biomed Pharmacol J. 2023;16(1):1-7. doi:10.13005/bpj/2650.
[30] Sun G, Zhang X, Shen YI, et al. Dextran hydrogel scaffolds enhance angiogenic responses and promote complete skin regeneration during burn wound healing. Proc Natl Acad Sci U S A. 2011;108(52):20976-81. doi:10.1073/pnas.1115973108.
[31] Zhu Y, Hoshi R, Chen S, et al. Injectable hydrogels with high loading capacity for protein delivery. *J Control Release.* 2015;206:203-10. doi:10.1016/j.jconrel.2015.03.032.
[32] Jeffcoate WJ, Vileikyte L, Boyko EJ, Armstrong DG, Boulton AJ. Current challenges and opportunities in the prevention and management of diabetic foot ulcers. Diabetes Care. 2018;41(4):645-52. doi:10.2337/dc17-1836.
[33] Armstrong DG, Boulton AJM, Bus SA. Diabetic Foot Ulcers and Their Recurrence. N Engl J Med. 2017;376(24):2367-75. doi:10.1056/NEJMra1615439.