



Отчет подобия

Метаданные

Название организации

National Scientific Center of Surgery named after A.N. Syzganov

Название

CLINICAL OBSERVATION OF HAND FUNCTION RECOVERY USING VARIOUS METHODS OF AUTOTENDON RECONSTRUCTION AND REHABILITATION

Автор

Mismil Muradov

Подразделение

National Scientific Center of Surgery named after A.N. Syzganov

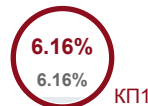
Тревога

В этом разделе вы найдете информацию, касающуюся текстовых искажений. Эти искажения в тексте могут говорить о ВОЗМОЖНЫХ манипуляциях в тексте. Искажения в тексте могут носить преднамеренный характер, но чаще, характер технических ошибок при конвертации документа и его сохранении, поэтому мы рекомендуем вам подходить к анализу этого модуля со всей долей ответственности. В случае возникновения вопросов, просим обращаться в нашу службу поддержки.

Замена букв		1
Интервалы		0
Микропробелы		0
Белые знаки		0
Парафразы (SmartMarks)		9

Объем найденных подобиий

КП-ия определяют, какой процент текста по отношению к общему объему текста был найден в различных источниках.. Обратите внимание!Высокие значения коэффициентов не означают плагиат. Отчет должен быть проанализирован экспертом.


25

Длина фразы для коэффициента подобия 2


2548

Количество слов

16957

Количество символов

Подобия по списку источников

Ниже представлен список источников. В этом списке представлены источники из различных баз данных. Цвет текста означает в каком источнике он был найден. Эти источники и значения Коэффициента Подобия не отражают прямого плагиата. Необходимо открыть каждый источник и проанализировать содержание и правильность оформления источника.

10 самых длинных фраз

Цвет текста

ПОРЯДКОВЫЙ НОМЕР	НАЗВАНИЕ И АДРЕС ИСТОЧНИКА URL (НАЗВАНИЕ БАЗЫ)	КОЛИЧЕСТВО ИДЕНТИЧНЫХ СЛОВ (ФРАГМЕНТОВ)	Цвет текста
1	Lymphosarcoma Incidence in Kazakhstan: A Retrospective Survey (2010-2019). N. Igissinov, F. Bayembayev, A. Saduakassova, Z. Bilyalova, Z. Telmanova, T. Dautov, R. Rakhimzhanova;	17	0.67 %
2	https://cyberleninka.ru/article/n/the-value-of-hemoglobin-content-in-children-with-community-acquired-pneumonia	15	0.59 %

3	Lymphosarcoma Incidence in Kazakhstan: A Retrospective Survey (2010-2019). N. Igissinov, F. Bayembayev, A. Saduakassova, Z. Bilyalova, Z. Telmanova, T. Dautov, R. Rakhimzhanova;	15 0.59 %
4	RESULTS OF GASTROINTESTINAL BLEEDING TREATMENT IN THE REPUBLIC OF KAZAKHSTAN OVER 10 YEARS 1/6/2025 National Scientific Center of Surgery named after A.N. Syzganov (National Scientific Center of Surgery named after A.N. Syzganov)	15 0.59 %
5	https://pubmed.ncbi.nlm.nih.gov/33789518/	13 0.51 %
6	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9360937/	12 0.47 %
7	https://pubmed.ncbi.nlm.nih.gov/33789518/	12 0.47 %
8	https://www.scielo.br/j/aem/a/yrfMKVbtdphTnWZ7qkpr6Vw/	11 0.43 %
9	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8713212/	9 0.35 %
10	Lymphosarcoma Incidence in Kazakhstan: A Retrospective Survey (2010-2019). N. Igissinov, F. Bayembayev, A. Saduakassova, Z. Bilyalova, Z. Telmanova, T. Dautov, R. Rakhimzhanova;	9 0.35 %

из базы данных RefBooks (1.92 %)

ПОРЯДКОВЫЙ НОМЕР	НАЗВАНИЕ	КОЛИЧЕСТВО ИДЕНТИЧНЫХ СЛОВ (ФРАГМЕНТОВ)
Источник: Paperity		
1	Lymphosarcoma Incidence in Kazakhstan: A Retrospective Survey (2010-2019). N. Igissinov, F. Bayembayev, A. Saduakassova, Z. Bilyalova, Z. Telmanova, T. Dautov, R. Rakhimzhanova;	49 (4) 1.92 %

из домашней базы данных (0.59 %)

ПОРЯДКОВЫЙ НОМЕР	НАЗВАНИЕ	КОЛИЧЕСТВО ИДЕНТИЧНЫХ СЛОВ (ФРАГМЕНТОВ)
1	RESULTS OF GASTROINTESTINAL BLEEDING TREATMENT IN THE REPUBLIC OF KAZAKHSTAN OVER 10 YEARS 1/6/2025 National Scientific Center of Surgery named after A.N. Syzganov (National Scientific Center of Surgery named after A.N. Syzganov)	15 (1) 0.59 %

из программы обмена базами данных (0.00 %)

ПОРЯДКОВЫЙ НОМЕР	НАЗВАНИЕ	КОЛИЧЕСТВО ИДЕНТИЧНЫХ СЛОВ (ФРАГМЕНТОВ)
------------------	----------	---

из интернета (3.65 %)

ПОРЯДКОВЫЙ НОМЕР	ИСТОЧНИК URL	КОЛИЧЕСТВО ИДЕНТИЧНЫХ СЛОВ (ФРАГМЕНТОВ)
1	https://pubmed.ncbi.nlm.nih.gov/33789518/	25 (2) 0.98 %
2	https://www.scielo.br/j/aem/a/yrfMKVbtdphTnWZ7qkpr6Vw/	18 (2) 0.71 %
3	https://cyberleninka.ru/article/n/the-value-of-hemoglobin-content-in-children-with-community-acquired-pneumonia	15 (1) 0.59 %
4	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8713212/	14 (2) 0.55 %

5	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9360937/	12 (1) 0.47 %
6	https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0206495	9 (1) 0.35 %

Список принятых фрагментов (нет принятых фрагментов)

ПОРЯДКОВЫЙ НОМЕР	СОДЕРЖАНИЕ	КОЛИЧЕСТВО ИДЕНТИЧНЫХ СЛОВ (ФРАГМЕНТОВ)
------------------	------------	---

Authors' Information:

Muradov Mismil Islamovich - Head of the Department of Reconstructive, Plastic, and Aesthetic Microsurgery, Syzganov National Scientific Center of Surgery. ORCID: 0000-0002-9168-8618. Phone: +7 707 989 8111. E-mail: mismil@yandex.ru

Kazantayev Kymbat Erikuly - Surgeon, Syzganov National Scientific Center of Surgery. ORCID: 0000-0002-3566-8719. Phone: +7 700 136 0076. E-mail: kimbax@mail.ru

Koshkarbayev Daniyar Zhambyluly - Surgeon, Syzganov National Scientific Center of Surgery. ORCID: 0000-0001-8158-1334. Phone: +7 707 822 9933. E-mail: dr.dan1992@gmail.com

Dosymkhanov Didar Samatuly - Resident, Syzganov National Scientific Center of Surgery. ORCID: 0009-0006-4077-3210. Phone: +7 778 464 9060. E-mail: dossymkhanovdi@gmail.com

Makataeva Dina Talgatkyzy - Resident, Syzganov National Scientific Center of Surgery. ORCID: 0000-002-6168-9644. Phone: +7 777 273 2277. E-mail: dinatalgatkyzy@gmail.com

Em Maksim Alexandrovich - Resident, Syzganov National Scientific Center of Surgery. ORCID: 0009-0002-1221-2994. Phone: +7 776 508 2639. E-mail: shut.em.down.onyx@mail.ru

Zhao Vyacheslav Jianghua - Rehabilitation Specialist, Traditional Medicine Doctor, "Meridian" Wellness Center, Karaganda. ORCID: 0009-0001-2487-7232. Phone: +7 747 212 3032. E-mail: dr.zhao@bk.ru

Shulgaubayev Altai Kamievich - Director of the Sarkand Central District Hospital. ORCID: 0009-0003-6646-7690. Phone: +7 777 268 5858. E-mail: Sarkand_crb@mail.ru

For correspondence: Koshkarbayev Daniyar Zhambyluly - Surgeon, Syzganov National Scientific Center of Surgery. ORCID: 0000-0001-8158-1334. Phone: +7 707 822 9933. E-mail: dr.dan1992@gmail.com

Conflicts **of interest: The authors declare no potential conflict of interest requiring disclosure in this article.**

ORIGINAL ARTICLE

CLINICAL OBSERVATION OF HAND FUNCTION RECOVERY USING VARIOUS METHODS OF AUTOTENDON RECONSTRUCTION AND REHABILITATION

Mismil Muradov,1 KymbatKazantayev,1 Daniyar Koshkarbayev,1 DidarDosymkhanov,1 DinaMakataeva,1 MaksimEM,1 Vyacheslav Zhzhao,2 Altai Shulgaubayev 3

1 - Syzganov National Scientific Surgery Center, Almaty, Kazakhstan

2 - Meridian Health Center, Karaganda, Kazakhstan

3 - Sarkand Central District Hospital, Sarkand, Kazakhstan

Annotation

Background To compare objective (range of motion, hand strength) and subjective (**Disabilities of the Arm, Shoulder, and Hand Questionnaire, Visual Analogue Scale measures pain** intensity scale) indicators of the effectiveness of one-stage and two-stage autograft reconstruction for different trauma durations combined with the Kleinert and SMART Hand Rehabilitation Method.

Methods The study included 200 patients (2021-2024) who underwent surgical treatment for flexor tendon injuries of the fingers at the Syzganov National Scientific Center of Surgery. Patients were divided into the main group (n = 80), which received two-stage reconstruction and rehabilitation using the SMART method, and the control group (n = 120) with one-stage reconstruction and rehabilitation according to the Kleinert method. The effectiveness was evaluated by range of motion, hand grip strength, Rozov's scale, Disabilities of the Arm, Shoulder, and Hand Questionnaire and Visual Analogue Scale pain scores.

Results By the 6th month of rehabilitation, the SMART method demonstrated better results in functional movement assessment (65% vs. 60%, p = 0.05), pain reduction (4.0 vs. 3.2, p < 0.05), and shorter return-to-work time (10 vs. 12 weeks, p < 0.05). However, the Kleinert method proved effective in patients with subacute injuries.

Conclusion The Stimulated Motion And Recovery Therapy hand rehabilitation method combined with two-stage reconstruction is effective for long-term injury consequences, while the Kleinert method is preferable for subacute injuries. Hand function recovery requires a multidisciplinary approach.

Keywords: Autograft reconstruction, hand injuries, Kleinert method, SMART Hand Rehabilitation Method, rehabilitation.

Introduction

Flexor tendon injuries of the fingers represent a serious medical problem, significantly reducing the functional potential of the hand, impairing patients' quality of life, and diminishing their work capacity. According to various studies, such injuries account for up to 15% of all hand injuries, particularly among the working-age population, leading to substantial socioeconomic consequences.1,2,3

Surgical treatment of flexor tendon injuries may include:

1. One-stage autogenous tendon grafting, optimal for injuries between 3 to 6 months old, as tissues maintain elasticity with minimal scarring.1,4,5

2. Two-stage grafting, used for long-term injuries (more than 6 months), where significant fibrotic changes necessitate tissue preparation for transplantation.6,7,8

Rehabilitation after surgery plays a crucial role in restoring hand function:

1. Kleinert method offers a conservative approach with gradual activation of movements, reducing the risk of complications but extending rehabilitation time.4

2. SMART (Stimulated Motion And Recovery Therapy) Hand Rehabilitation Method focuses on early mobilization, autologous plasma therapy, and high-intensity physiotherapy, promoting faster recovery but requiring careful pain management.9

Objective: Comparative analysis of objective (range of motion, hand strength) and subjective (**Disabilities of the Arm, Shoulder, and Hand (DASH) Questionnaire, Visual Analogue Scale (VAS) measures pain** intensity scale indicators of the effectiveness of one-stage and two-stage autogenous tendon grafting for various injury durations combined with Kleinert and SMART rehabilitation products.

Materials and Methods

The study was conducted as a prospective clinical observation involving 200 patients from 2021 to 2024 at the Syzganov National Scientific Center of Surgery, who underwent surgical treatment for the consequences of flexor tendon injuries of the fingers.

Patients were divided into two groups:

1. Main Group (MG, n = 80): Patients with long-term injury consequences (more than 6 months) who underwent two-stage grafting followed by rehabilitation using the SMART Hand Rehabilitation Method.

2. Control Group (CG, n = 120): Patients with injuries from 3 to 6 months old, treated with one-stage grafting and rehabilitation according to the Kleinert method.

Inclusion and exclusion criteria:

1. Included: Patients with flexor tendon injuries of the hand from 3 months to 1 year, without severe somatic diseases.

2. Excluded: Patients with infections, systemic connective tissue diseases, or severe contractures.

Methods of assessing effectiveness:

Objective indicators:

1. Range of motion: Measured by goniometer (in degrees).

2. Hand grip strength: Assessed by dynamometer (in kilograms).

3. V.I. Rozov scale: Functional assessment of movements on a 5-point scale.

Subjective indicators:

1. DASH questionnaire: Assessment of functional limitations of the upper limb.

2. Pain scale VAS: Intensity of pain syndrome (0-10 points).

Ethical approval The **study protocol was approved by the Ethics Committee of** the A.O. Syzganov National Scientific Center of Surgery (Protocol No. 15/2021), **and all patients provided informed consent prior to participation.**

Statistics **Statistical analysis was performed using SPSS software (version 25.0). Quantitative data were expressed as mean ± standard deviation (SD). Student's t-test was used for comparison of continuous variables, t-statistic and Chi-square test was applied for categorical variables. A p-value <0.05 was considered statistically significant. Results**

Table 1. Characteristics according Rozov's Scale

Observation Period	Main Group n=80	Control Group n=120	95%CI	Chi-squared	P value
3 months	50% - 4-5 points	45% - 4-5 points	[8.9;18.7]	0.479	0.489
6 months	65% - 4-5 points	60% - 4-5 points	[8.7; 18.1]	0.507	0.476

Data from Table 1 show that by the 6th month of rehabilitation, the SMART method (main group) demonstrates slightly better results in functional movement assessment than the Kleinert method (control group), although the statistical significance is at the threshold ($p = 0.05$).

Table 2. DASH questionnaire survey data

Observation Period	Main Group n=80	Control Group n=120	P value
3 months	40.2 35.1		<0.05*
6 months	34.8 28.5		<0.05*

According to Table 2, patients in the main group showed more pronounced functional limitations on the DASH scale at all stages of observation, which may be due to the chronic nature of their injuries.

Table 3. Additional Rehabilitation Indicators

Indicator	Main Group n=80	Control Group n=120	95%CI	t-statistic	P value
Pain scale (VAS)	4.0 ± 1.0	3.2 ± 0.8	[0.5; 1.1]	6.26	<0.0001*
Range of motion (°)	130 ± 8	120 ± 10	[7.4; 12.6]	7.49	<0.0001*
Hand grip strength (kg)	20.0 ± 1.5	18.0 ± 2.0	[1.4; 2.5]	7.63	<0.0001*
Time to return to work (weeks)	10.0 ± 1.0	12.0 ± 1.5	[1.6; 2.4]	10.47	<0.0001*

*Statistically significant difference $P \leq 0.05$

The SMART method allows achieving a higher range of motion and hand grip strength with less pain syndrome, contributing to an earlier return to work presented in Table 3.

Discussion

The study results showed that the use of the SMART Hand Rehabilitation Method combined with two-stage grafting provides higher recovery rates of hand function in patients with long-term injury consequences. The main group demonstrated significant improvements in range of motion, hand grip strength, and reduced time to return to work compared to the control group. This is consistent with other studies confirming the effectiveness of early mobilization and high-intensity physiotherapy in hand rehabilitation.10-12

The Kleinert method, while showing good results in patients with subacute injuries, was less effective under conditions of pronounced fibrotic changes, confirming the need for an individualized approach to selecting a rehabilitation method depending on the duration of the injury.13-15.

These findings emphasize the importance of adapting rehabilitation strategies based on injury duration and severity. The SMART Hand Rehabilitation method's early mobilization protocols potentially reduce the formation of adhesions, allowing for quicker and more complete functional recovery. However,

the potential risks associated with intensive rehabilitation, such as pain or re-injury, require careful management and individualized planning.^{11,12,16} Furthermore, the study highlights the necessity of combining surgical and rehabilitation strategies for optimal outcomes. The integration of autologous plasma therapy as part of the SMART Hand Rehabilitation Method may contribute to enhanced tissue healing, which could explain the faster recovery times observed in the main group. The reduced time to return to work not only benefits the patients but also has positive socioeconomic implications, reducing the overall burden on healthcare systems and improving patients' quality of life.^{7,11,16}

Comparing our results with existing literature, it becomes evident that the SMART Hand Rehabilitation Method, although more intensive, offers substantial advantages in chronic injury cases. However, future studies should address the long-term sustainability of these improvements and investigate potential complications associated with intensive rehabilitation techniques. Additionally, exploring the psychological aspects of recovery, including patient motivation and adherence to rehabilitation protocols, could provide a more holistic view of treatment effectiveness.^{7,8}

Limitations The study's limitations include the relatively small sample size and the short follow-up period. Additionally, the study was conducted in a single medical center, which may limit the generalizability of the results.

What's known? Previous studies have highlighted the effectiveness of the Kleinert method for flexor tendon injuries, particularly in subacute stages. However, there was limited evidence comparing it with more intensive rehabilitation protocols such as the SMART Hand Rehabilitation Method, especially in long-term injury cases.

What's new? This study provides new insights into the benefits of the SMART Hand Rehabilitation Method in conjunction with two-stage grafting, demonstrating superior outcomes in range of motion, pain reduction, and return to work speed for chronic injury patients.

Conclusion

The SMART Hand Rehabilitation Method combined with two-stage grafting demonstrates significant improvement in functional outcomes in long-term injury cases. The Kleinert method is effective for patients with injuries up to 6 months, especially among young patients. Restoring hand function requires a multidisciplinary approach, including surgeons, rehabilitation specialists, and psychologists. Further research with a larger sample size and long-term follow-up is needed.

Acknowledgements The authors thank the Syzganov National Scientific Center of Surgery for providing clinical support and all the medical staff involved in the rehabilitation process.

Authors' Contributions M.M., K.K., D.K.: **Concept, design, and control of the research, approval of the final version of the article**; D.D., D.M., M.E.: **Collection and preparation of data, primary processing of the material, and their verification**; V.Zh., A.Sh.: **Statistical processing and analysis of the material, writing the text of the article (material and methods, results)**; D.D., D.M., M.E.: **Writing the text of the article (introduction, discussion)**. **All authors approved the final version of the manuscript.**

Funding No

References

1. Tsumura T, Matsumoto T, Matsushita M, Kishimoto K, Shiode H, Murakami H. Severe hand contracture treated by external fixation after proximal row carpectomy and awake tenolysis after general anesthesia: A case report. *Chin J Traumatol*. Jan 2022;25(1):54-58. doi:10.1016/j.cjtee.2021.08.008
2. Lee JK, Oh CH, Oh J, Jeong S, Lim CK, Han SH. Surgical Treatment for Patients with Post-traumatic Flexion Contracture of Proximal Interphalangeal Joint: Analysis of Various Affecting Factors. *J Hand Surg Asian Pac Vol*. Dec 2023;28(6):642-650. doi:10.1142/S2424835523500674
3. Madan Mohan SN, Rajendiran S, Rajappa S. Management of Patients With Post-Traumatic Wrist Flexor Contracture by Carpectomy and Wrist Fusion. *Cureus*. Nov 2023;15(11):e48812. doi:10.7759/cureus.48812
4. Banihani J, Choukou MA. A home-based hand rehabilitation platform for hemiplegic patients after stroke: A feasibility study. *Heliyon*. Aug 30 2024;10(16):e35565. doi:10.1016/j.heliyon.2024.e35565
5. Shutze W, Gierman J, McQuade K, Pearl G, Smith B. Treatment of proximal vertebral artery disease. *Vascular*. Apr 2014;22(2):85-92. doi:10.1177/1708538112473966
6. Challoumas D, Ramasubbu R, Rooney E, Seymour-Jackson E, Putti A, Millar NL. Management of de Quervain Tenosynovitis: A Systematic Review and Network Meta-Analysis. *JAMA Netw Open*. Oct 2 2023;6(10):e2337001. doi:10.1001/jamanetworkopen.2023.37001
7. Pearce O, Brown MT, Fraser K, Lancerotto L. Flexor tendon injuries: Repair & Rehabilitation. *Injury*. Aug 2021;52(8):2053-2067. doi:10.1016/j.injury.2021.07.036
8. Yalcin G, Mulkoglu C, Gulmez S, Genc H. The effect of mirror therapy in the rehabilitation of flexor tendon injuries after primary surgical repair. *Hand Surg Rehabil*. Feb 2024;43(1):101612. doi:10.1016/j.hansur.2023.10.006
9. Leti Acciaro A, Colzani G, Starnoni M, Adani R. The Challenges in restoration of extensor tendons function at the hand. *Acta Biomed*. Apr 30 2021;92(S1):e2021151. doi:10.23750/abm.v92iS1.9756
10. Neiduski RL, Powell RK. Flexor tendon rehabilitation in the 21st century: A systematic review. *J Hand Ther*. Apr-Jun 2019;32(2):165-174. doi:10.1016/j.jht.2018.06.001
11. Peters SE, Jha B, Ross M. Rehabilitation following surgery for flexor tendon injuries of the hand. *Cochrane Database Syst Rev*. Jan 13 2021;1(1):CD012479. doi:10.1002/14651858.CD012479.pub2
12. Tang JB. Rehabilitation after flexor tendon repair and others: a safe and efficient protocol. *J Hand Surg Eur Vol*. Oct 2021;46(8):813-817. doi:10.1177/17531934211037112
13. Soltani A, Zargaran A, Kang N. Post-traumatic Dupuytren's contracture in a paediatric patient: a case report and literature review. *Case Reports Plast Surg Hand Surg*. 2024;11(1):2436678. doi:10.1080/23320885.2024.2436678
14. Qi W, Jiang P, Aiyuan W, Wenjing X, Jinshu T, Jinshu T. Treatment and rehabilitation of post-traumatic elbow stiffness with heterotopic ossification. *J Plast Surg Hand Surg*. Feb 4 2024;59:18-23. doi:10.2340/jphs.v59.18363
15. Guglielmetti CLB, Gracitelli MEC, Assuncao JH, et al. Randomized trial for the treatment of post-traumatic elbow stiffness: surgical release vs. rehabilitation. *J Shoulder Elbow Surg*. Aug 2020;29(8):1522-1529. doi:10.1016/j.jse.2020.03.023
16. Kazantayev KE, Mukhamedkerim KB, Muradov MI, Nabiyeu Y, Turdalieva BS. Restoring Function of the Flexor Tendons of the Hand: State of the Science in Kazakhstan. *Plast Aesthet Nurs (Phila)*. Oct-Dec 01 2023;43(4):219-224. doi:10.1097/PSN.0000000000000530