ORIGINAL ARTICLE

Effectiveness of the Lace Method in Osteosynthesis for Hand Fractures in the Kyrgyz Republic

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Abstract

Introduction: Hand fracture management remains complex, with treatment approaches varying based on fracture type, patient characteristics, and healthcare system constraints. **Objectives:** This retrospective study aimed to determine the effectiveness of the lace method of osteosynthesis in the Kyrgyz Republic and the anesthetic aspects of this method. **Materials and Methods:** Patients aged 3–71 years with confirmed wrist fractures were divided into two groups: Group 1 (n = 90) underwent cord osteosynthesis, while Group 2 (n = 34) received standard osteosynthesis treatment. The study compared general and administrative indicators of medical care quality between the groups. **Results:** Domestic injuries were prevalent in all groups and categories, while work injuries had a more stable distribution. Conductor cells accounted for the majority of anesthesia types in both groups (42.20% in Group 1 and 50.00% in Group 2). Group 1 had a higher percentage of local and general anesthesia, whereas Group 2 had a higher content of conductive anesthesia. The age distribution differed between the groups, with Group 1 primarily composed of children of primary and secondary school age, while Group 2 had a higher proportion of adults aged 18–50 years. **Conclusion:** The findings suggest differences in the composition of anesthesia used and age distribution between the two groups, which may have implications for treatment outcomes and functional activity. Further research is needed to establish standardized guidelines for hand fracture management and to evaluate the effectiveness of the lace method of osteosynthesis in various patient populations.

Key words: Anesthesia, hand fractures, lace method, osteosynthesis, surgical treatment, traumatic injuries

INTRODUCTION

Current hand fracture treatments involve balancing conservative and surgical methods, with surgical techniques specific to the fracture type.[1] Thumb fractures, due to their unique anatomy and functional significance, require particular attention, but no universal standards exist.[2] Senior surgeons typically opt for non-operative or minimally invasive methods, reserving invasive procedures for complex cases.[3]

Global practice patterns vary significantly and are influenced by resources, geography, social factors, and surgeon experience.[4] In pediatric care, efficient management of simple hand fractures and improved parental education are essential, emphasizing streamlined referrals and multidisciplinary connections.[5] Early mobilization post-stabilization is critical for successful treatment;[6] however, a survey of Canadian plastic surgeons revealed inconsistencies, with a preference for immobilization post-splinting.[7]

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Non-operative techniques are generally preferred, but operative fixation may be required in certain cases, with various surgical options available.[8] Hand fracture management is complex and is influenced by fracture type, patient characteristics, and healthcare system constraints. Despite a trend toward less invasive methods and early mobilization, inconsistencies remain, underscoring the need for standardized guidelines.[7,8] The literature lacks direct evidence for the effectiveness of the lace method in osteosynthesis. The purpose of this study was to determine the effectiveness and anesthetic aspects of the lace method of osteosynthesis in the Kyrgyz Republic.

MATERIALS AND METHODS

This is a retrospective analysis of patient data from the hand microsurgery department of the National Hospital of the Ministry of Health of the Kyrgyz Republic for the period spanning from 2018 to 2023. To be eligible for inclusion in the study, patients had to meet the following criteria: Age between 3 and 71 years (excluding children and older adults with hand fractures that may have unique characteristics), a confirmed clinical and/or radiological diagnosis of wrist fracture, provision of informed consent to participate in the study and receive treatment, and absence of serious complications or concomitant diseases.

The selected patients were then divided into two groups: Group 1 (n = 90) comprised patients with a traumatic hand fracture who underwent cord osteosynthesis, and Group 2 (n = 34) consisted of patients who received standard osteosynthesis treatment. This study compared general and administrative indicators of medical care quality in hospitals between the two groups. This study was conducted in compliance with the principles outlined in the Declaration of Helsinki, 2013, and was approved by the Bioethical Committee of the International Higher School of Medicine (Protocol No. 12, dated May 12, 2022).

Statistical analysis, version 11.5 of the Statistical Package for the Social Sciences, was employed. The results are presented as mean ± standard deviation and n (%), and a paired t-test was used to evaluate the variations in treatment and outcomes across the participating sites. The test assumed equal variances for both samples, and the findings indicated statistically significant differences in platelet count, length of therapy, hospitalization duration, and demographic characteristics ($P < 0.05$).

RESULTS

Figure 1 shows the percentage distribution of injuries according to source and category. There are four main categories of injuries: Domestic, industrial, and street injuries. Each category was further divided into three groups. For each injury category, the percentage of cases in each of the three groups (1st, 2nd, and 3rd) is presented, as well as the number of cases in each of the two categories (3 and 4).

From Figure 1, it is evident that the largest percentage of injuries in any category occurred in Group 1. Domestic injuries are prevalent in all groups and categories, whereas work injuries have a more stable distribution between groups than street and other injuries that have a more variable distribution. Given these data, it can be inferred that it is important to pay more attention to the prevention of domestic injuries because they constitute a significant proportion of the total number of traumatic cases. It is also worth focusing on factors that influence workplace injuries to reduce their incidence and improve workplace safety.

Figure 2 shows the distribution percentages of the different anesthesia types in the samples. The measurements included local, general, conductor, and other types of cells. The results are presented for the two groups: Group 1 and Group 2. In Group 1, conductor cells accounted for the majority (42.20%) of the cells, indicating their significant presence. Local anesthesia was also present (26.60%) and general cells constituted 31.10% of the total anesthesia. Other types of anesthesia comprised only a small portion (4.40%). Group 2

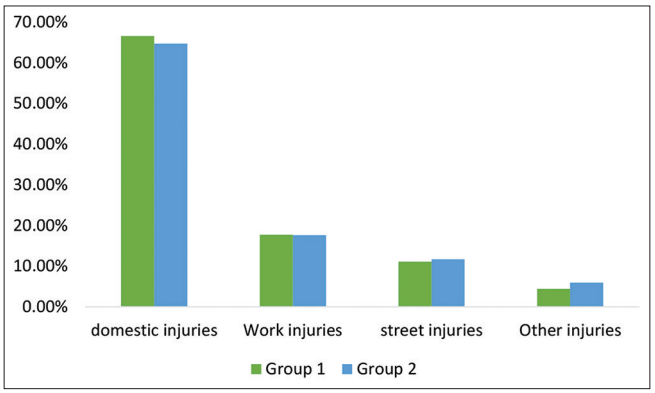

Figure 1: Percentage of causes of hand injury in groups according to the use of the studied methods of surgical treatment

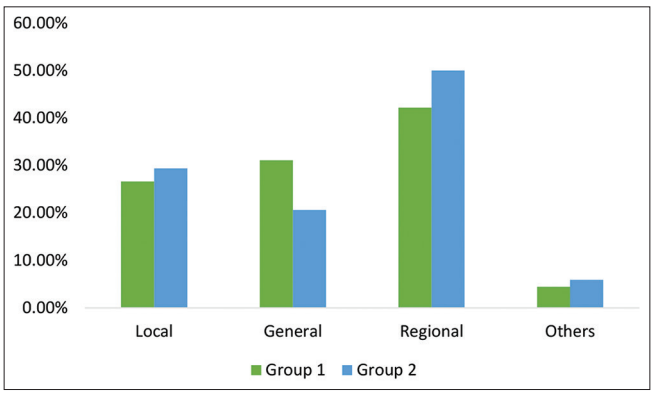

Figure 2: Percentage of anesthesia methods in groups according to the use of the studied methods of surgical treatment

had conductor cells in the largest proportion (50.00%), indicating their dominance in this group. Local cells were the second highest (29.40%), followed by general cells (20.60%). Other types of anesthesia were administered in 5.90% of patients. In general, these results showed differences in the composition of the anesthetic used between the two groups. Group 1 had a higher percentage of local and general anesthesia, whereas Group 2 had a higher percentage of conductive anesthesia. This difference may suggest differences in functional activity or tissue type between the two groups.

Figure 3 depicts the age distribution of the two distinct groups (Groups 1 and 2) by showing the percentage of individuals falling within five age categories (<10 years, 11–17 years, 18–30 years, 31–50 years, and >50 years). Group 1 consists of the following age groups: The largest proportion of individuals <10 years of age (35.50%), followed by those aged 11–17 years (7.70%), 18–30 years (17.70%), 31–50 years (32.20%), and those over 50 years of age (6.70%). Group 2, on the other hand, had a significantly different age distribution, with a lower proportion of individuals <10 years of age (8.80%), a slightly higher proportion of those aged 11–17 years (5.80%), a higher proportion of 18–30 year-olds (29.40%), a much higher proportion of 31–50 year-olds (38.20%), and a lower proportion of those over 50 years of age (17.60%).

The age distribution in Group 1 suggests that it is primarily composed of children of primary and secondary school age as well as middle-aged individuals (31–50 years old), whereas Group 2 appears to be dominated by middle and mature individuals (18–50 years old). This difference in age distribution suggests that the two groups likely represent different demographic segments or have different goals and interests.

Figure 4 illustrates the time distribution for task completion across four groups (Groups 1, 2, 3, and 4). The time intervals were categorized as <5 days, 6–10 days, and >10 days, with an additional "Other" category for outliers. Group 1:26.60% of tasks were completed <5 days, 73.40% within 6–10 days, and none in >10 days. In addition, 4.40% of the cases fell into the "Other" category. Group 2: No tasks were completed <5 days, 79.40% within 6–10 days, 20.60% in >10 days, and 5.90% fell into the "Other" category. Group 3: Average completion times were 3.5 days for <5 days, 1.8 days for 6–10 days, and 3 days for >10 days. Group 4: Average times were 4.5 days for <5 days, 2.8 days for 6–10 days, and 5 days for >10 days. Most tasks in both groups required 6–10 days, Group 1 had more tasks completed within this range, whereas Group 2 had a higher proportion of tasks that took >10 days. Categories 3 and 4 had similar timescales, indicating that the tasks in these categories generally took less time to complete.

Table 1 compares the anesthetic scales and wound characteristics between the two study groups: 90 patients in Group 1 and 34 in Group 2. The National Nosocomial Infections Surveillance (NNIS) index, assessing infection risk post-surgery, was significantly lower in Group 1 (0.38 ± 0.067) than in Group 2 (0.74±) (P = 0.005). The American Society of Anesthesiologists (ASA) scale, which evaluates pre-operative physical status, was also significantly lower in Group 1 (1.41 ± 0.066) than in Group 2 (2.63±) (P = 0.018). While no significant difference was found in the wound class (P = 0.5), wound size was significantly smaller in Group 1 (2.01 ± 0.148 mm) than in Group 2 (4.93 ± 0.588 mm) (P = 0.05). These findings indicate that patients in Group 1 had a lower infection risk, better pre-operative physical condition, and smaller wound sizes, potentially

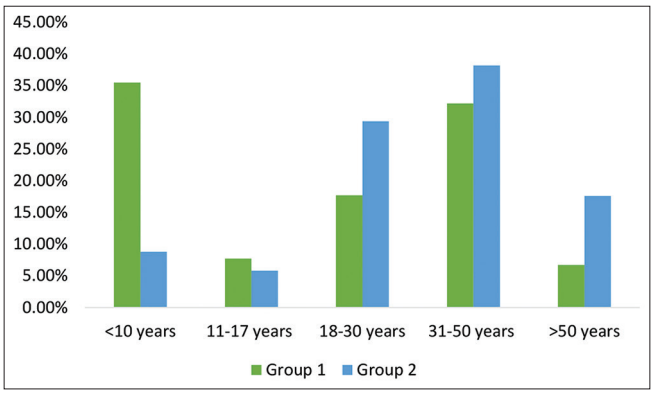

Figure 3: Percentage of age categories in groups according to the use of the studied methods of surgical treatment

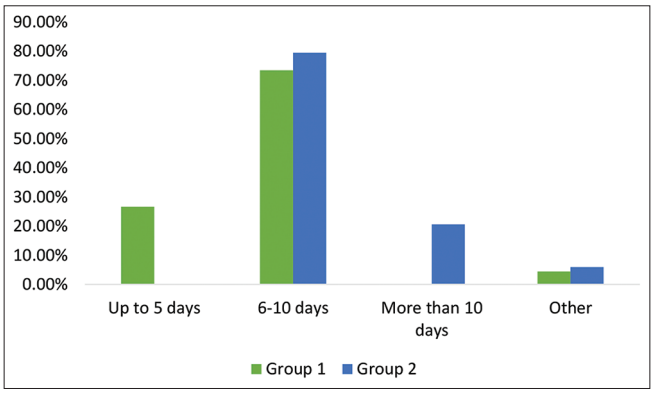

Figure 4: Percentage of hospital bed days in groups according to the use of the studied methods of surgical treatment

Table 1: Comparison of anesthetic scales and wound characteristics in the study groups

Characteristics		Group 1 (*n*=90)	Group 2 (*n*=34)	*P*
1.	NNIS index	0.38±0.067	0.74±0.156	0.005
2.	ASA scale	1.41±0.066	2.63±0.148	0.018
3.	Wound class	2.0±0.055	0.06±0.103	0.5
4.	Wound dimensions in mm	2.01±0.148	4.93±0.588	0.05

NNIS: National Nosocomial Infections Surveillance, ASA: American Society of Anesthesiologists. Values are expressed as mean±standard deviation. *P<0.05

Table 2: Comparison of anesthetic scales and wound characteristics for different anesthesia methods

Characteristics		Local (*n*=89)	General (*n*=34)	*P*
1.	NNIS index	0.4±0.072	0.8±0.121	0.005
2.	ASA scale	1.21±0.059	2.06±0.103	0.001
3.	Wound class	2.06±0.058	1.91±0.098	0.19
4.	Wound dimensions in mm	3.54±1.412	1.7±0.2	0.44

NNIS: National Nosocomial Infections Surveillance, ASA: American Society of Anesthesiologists. Values are expressed as mean±standard deviation. *P<0.05

aiding in pre-operative and post-operative management strategies.

Table 2 compares the anesthetic scores and wound characteristics between the local (n = 89) and general anesthesia (n = 34) techniques. The parameters included the following: No. (number of parameters), parameters (name), local (average for local anesthesia), general (average for general anesthesia), and P (statistical significance). The NNIS index, assessing post-surgery infectious complications, was 0.4 ± 0.072 for local anesthesia and 0.8 ± 0.121 for general anesthesia (P = 0.005), indicating a significant increase in complications with general anesthesia. The ASA scale, evaluating pre-surgery physical condition, averaged 1.21 ± 0.059 for local anesthesia and 2.06 ± 0.103 for general anesthesia (P = 0.001), showing a significant increase in physical activity severity with general anesthesia. Wound class and injury severity rating showed no significant difference (P = 0.19) between the groups. Mean wound dimensions were 3.54 ± 1.412 mm for local anesthesia and 1.7 ± 0.2 mm for general anesthesia, with no significant difference (P = 0.44).

Thus, general anesthesia is associated with a higher severity of infectious complications and physical condition, whereas injury severity and wound size remain similar between anesthesia methods.

DISCUSSION

Alexandre *et al*. highlighted the necessity of comprehending bone fracture biomechanics and osteosynthesis, along with understanding implants and their mechanical properties, which could be pertinent if the lace method utilizes specific implants or techniques interacting with biomechanical forces.[9]

Anesthesia during hand fracture surgery is vital for patient comfort, operational efficiency, and post-operative recovery.[10] Several studies have examined anesthesia in orthopedic surgery, including the Wide-Awake Local Anesthesia No Tourniquet (WALANT) technique by Ahmad *et al*. for distal radius fractures, which could be relevant to the lace method in similar contexts.[11] Niempoog *et al*. reported WALANT's effectiveness of WALANT in clavicular fracture surgery.[12] Gojkovic *et al*. and Lee *et al*. highlighted the benefits of spinal and regional anesthesia in orthopedic surgery, such as reduced post-operative complications and suitability for elderly patients.[13,14] Chorn and Wang *et al*. discussed the versatile anesthetic management required in orthopedic surgeries, applicable to the lace method, if relevant.[15,16] Wakuno *et al*. described an anesthetic technique for racehorses in long-term orthopedic surgery, indicating broad considerations in orthopedic anesthesia, although not directly applicable to humans.[17]

Osteosynthesis biomechanics are well understood, although evidence on the efficacy of the lace method is lacking.[9] Anesthetic approaches for orthopedic procedures, including WALANT and regional anesthesia, are well established and adaptable to diverse patient and surgical situations.[11-17] Our previous retrospective analysis of cord osteosynthesis versus standard osteosynthesis for treating hand bone fractures in the Kyrgyz Republic indicated that cord osteosynthesis may offer better efficacy in treating these types of fractures than the standard approach.[18]

CONCLUSION

Domestic injuries account for a significant proportion of all trauma cases. Preventing workplace injuries is crucial for enhancing overall safety. The first group used more local and general anesthetics, whereas the second group primarily used conduction anesthesia. This variation suggests different functional activities or tissue types between groups. Demographic characteristics categorized the groups, revealing distinct age distributions and interests. Group 1 was assigned more tasks to be completed in 6–10 days, whereas Group 2 managed more projects exceeding 10 days, indicating that Group 1 had more transient markers. The first group exhibited better infection resistance, superior pre-operative physical condition, and a smaller wound size than the second group. These findings may guide the development of new post-operative care protocols.

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