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ЕЖЕМЕСЯЧНЫЙ НАУЧНЫЙ ЖУРНАЛ

Медицинские новости Грузии

საქართველოს სამედიცინო სიახლენი

GEORGIAN MEDICAL NEWS

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GMN: Georgian Medical News is peer-reviewed, published monthly journal committed to promoting the science and art of medicine and the betterment of public health, published by the GMN Editorial Board since 1994. GMN carries original scientific articles on medicine, biology and pharmacy, which are of experimental, theoretical and practical character; publishes original research, reviews, commentaries, editorials, essays, medical news, and correspondence in English and Russian.

GMN is indexed in MEDLINE, SCOPUS, PubMed and VINITI Russian Academy of Sciences. The full text content is available through EBSCO databases.

GMN: Медицинские новости Грузии - ежемесячный рецензируемый научный журнал, издаётся Редакционной коллегией с 1994 года на русском и английском языках в целях поддержки медицинской науки и улучшения здравоохранения. В журнале публикуются оригинальные научные статьи в области медицины, биологии и фармации, статьи обзорного характера, научные сообщения, новости медицины и здравоохранения. Журнал индексируется в MEDLINE, отражён в базе данных SCOPUS, PubMed и ВИНИТИ РАН. Полнотекстовые статьи журнала доступны через БД EBSCO.

GMN: Georgian Medical News – საქართველოს სამედიცინო სიახლენი – არის ყოველთვიური სამეცნიერო სამედიცინო რეცენზირებადი ჟურნალი, გამოიცემა 1994 წლიდან, წარმოადგენს სარედაქციო კოლეგიისა და აშშ-ის მეცნიერების, განათლების, ინდუსტრიის, ხელოვნებისა და ბუნებისმეტყველების საერთაშორისო აკადემიის ერთობლივ გამოცემას. GMN-ში რუსულ და ინგლისურ ენებზე ქვეყნდება ექსპერიმენტული, თეორიული და პრაქტიკული ხასიათის ორიგინალური სამეცნიერო სტატიები მედიცინის, ბიოლოგიისა და ფარმაციის სფეროში, მიმოხილვითი ხასიათის სტატიები.

ჟურნალი ინდექსირებულია MEDLINE-ის საერთაშორისო სისტემაში, ასახულია SCOPUS-ის, PubMed-ის და ВИНИТИ РАН-ის მონაცემთა ბაზებში. სტატიების სრული ტექსტი ხელმისაწვდომია EBSCO-ს მონაცემთა ბაზებიდან.

WEBSITE

www.geomednews.com

К СВЕДЕНИЮ АВТОРОВ!

При направлении статьи в редакцию необходимо соблюдать следующие правила:

1. Статья должна быть представлена в двух экземплярах, на русском или английском языках, напечатанная через **полтора интервала на одной стороне стандартного листа с шириной левого поля в три сантиметра**. Используемый компьютерный шрифт для текста на русском и английском языках - **Times New Roman** (**Кириллица**), для текста на грузинском языке следует использовать **AcadNusx.** Размер шрифта - **12**. К рукописи, напечатанной на компьютере, должен быть приложен CD со статьей.

2. Размер статьи должен быть не менее десяти и не более двадцати страниц машинописи, включая указатель литературы и резюме на английском, русском и грузинском языках.

3. В статье должны быть освещены актуальность данного материала, методы и результаты исследования и их обсуждение.

При представлении в печать научных экспериментальных работ авторы должны указывать вид и количество экспериментальных животных, применявшиеся методы обезболивания и усыпления (в ходе острых опытов).

4. К статье должны быть приложены краткое (на полстраницы) резюме на английском, русском и грузинском языках (включающее следующие разделы: цель исследования, материал и методы, результаты и заключение) и список ключевых слов (key words).

5. Таблицы необходимо представлять в печатной форме. Фотокопии не принимаются. **Все цифровые, итоговые и процентные данные в таблицах должны соответствовать таковым в тексте статьи**. Таблицы и графики должны быть озаглавлены.

6. Фотографии должны быть контрастными, фотокопии с рентгенограмм - в позитивном изображении. Рисунки, чертежи и диаграммы следует озаглавить, пронумеровать и вставить в соответствующее место текста **в tiff формате**.

В подписях к микрофотографиям следует указывать степень увеличения через окуляр или объектив и метод окраски или импрегнации срезов.

7. Фамилии отечественных авторов приводятся в оригинальной транскрипции.

8. При оформлении и направлении статей в журнал МНГ просим авторов соблюдать правила, изложенные в «Единых требованиях к рукописям, представляемым в биомедицинские журналы», принятых Международным комитетом редакторов медицинских журналов - http://www.spinesurgery.ru/files/publish.pdf и http://www.nlm.nih.gov/bsd/uniform_requirements.html
В конце каждой оригинальной статьи приводится библиографический список. В список литературы включаются все материалы, на которые имеются ссылки в тексте. Список составляется в алфавитном порядке и нумеруется. Литературный источник приводится на языке оригинала. В списке литературы сначала приводятся работы, написанные знаками грузинского алфавита, затем кириллицей и латиницей. Ссылки на цитируемые работы в тексте статьи даются в квадратных скобках в виде номера, соответствующего номеру данной работы в списке литературы. Большинство цитированных источников должны быть за последние 5-7 лет.

9. Для получения права на публикацию статья должна иметь от руководителя работы или учреждения визу и сопроводительное отношение, написанные или напечатанные на бланке и заверенные подписью и печатью.

10. В конце статьи должны быть подписи всех авторов, полностью приведены их фамилии, имена и отчества, указаны служебный и домашний номера телефонов и адреса или иные координаты. Количество авторов (соавторов) не должно превышать пяти человек.

11. Редакция оставляет за собой право сокращать и исправлять статьи. Корректура авторам не высылается, вся работа и сверка проводится по авторскому оригиналу.

12. Недопустимо направление в редакцию работ, представленных к печати в иных издательствах или опубликованных в других изданиях.

При нарушении указанных правил статьи не рассматриваются.

REQUIREMENTS

Please note, materials submitted to the Editorial Office Staff are supposed to meet the following requirements:

1. Articles must be provided with a double copy, in English or Russian languages and typed or compu-ter-printed on a single side of standard typing paper, with the left margin of **3** centimeters width, and **1.5** spacing between the lines, typeface - **Times New Roman** (**Cyrillic**), print size - **12** (referring to Georgian and Russian materials). With computer-printed texts please enclose a CD carrying the same file titled with Latin symbols.

2. Size of the article, including index and resume in English, Russian and Georgian languages must be at least 10 pages and not exceed the limit of 20 pages of typed or computer-printed text.

3. Submitted material must include a coverage of a topical subject, research methods, results, and review.

Authors of the scientific-research works must indicate the number of experimental biological species drawn in, list the employed methods of anesthetization and soporific means used during acute tests.

4. Articles must have a short (half page) abstract in English, Russian and Georgian (including the following sections: aim of study, material and methods, results and conclusions) and a list of key words.

5. Tables must be presented in an original typed or computer-printed form, instead of a photocopied version. **Numbers, totals, percentile data on the tables must coincide with those in the texts of the articles.** Tables and graphs must be headed.

6. Photographs are required to be contrasted and must be submitted with doubles. Please number each photograph with a pencil on its back, indicate author's name, title of the article (short version), and mark out its top and bottom parts. Drawings must be accurate, drafts and diagrams drawn in Indian ink (or black ink). Photocopies of the X-ray photographs must be presented in a positive image in **tiff format**.

Accurately numbered subtitles for each illustration must be listed on a separate sheet of paper. In the subtitles for the microphotographs please indicate the ocular and objective lens magnification power, method of coloring or impregnation of the microscopic sections (preparations).

7. Please indicate last names, first and middle initials of the native authors, present names and initials of the foreign authors in the transcription of the original language, enclose in parenthesis corresponding number under which the author is listed in the reference materials.

8. Please follow guidance offered to authors by The International Committee of Medical Journal Editors guidance in its Uniform Requirements for Manuscripts Submitted to Biomedical Journals publication available online at: http://www.nlm.nih.gov/bsd/uniform_requirements.html
http://www.icmje.org/urm_full.pdf
In GMN style for each work cited in the text, a bibliographic reference is given, and this is located at the end of the article under the title "References". All references cited in the text must be listed. The list of references should be arranged alphabetically and then numbered. References are numbered in the text [numbers in square brackets] and in the reference list and numbers are repeated throughout the text as needed. The bibliographic description is given in the language of publication (citations in Georgian script are followed by Cyrillic and Latin).

9. To obtain the rights of publication articles must be accompanied by a visa from the project instructor or the establishment, where the work has been performed, and a reference letter, both written or typed on a special signed form, certified by a stamp or a seal.

10. Articles must be signed by all of the authors at the end, and they must be provided with a list of full names, office and home phone numbers and addresses or other non-office locations where the authors could be reached. The number of the authors (co-authors) must not exceed the limit of 5 people.

11. Editorial Staff reserves the rights to cut down in size and correct the articles. Proof-sheets are not sent out to the authors. The entire editorial and collation work is performed according to the author's original text.

12. Sending in the works that have already been assigned to the press by other Editorial Staffs or have been printed by other publishers is not permissible.

Articles that Fail to Meet the Aforementioned Requirements are not Assigned to be Reviewed.

ავტორთა საყურადღებოდ!

რედაქციაში სტატიის წარმოდგენისას საჭიროა დავიცვათ შემდეგი წესები:

1. სტატია უნდა წარმოადგინოთ 2 ცალად, რუსულ ან ინგლისურ ენებზე,დაბეჭდილი სტანდარტული ფურცლის 1 გვერდზე, 3 სმ სიგანის მარცხენა ველისა და სტრიქონებს შორის 1,5 ინტერვალის დაცვით. გამოყენებული კომპიუტერული შრიფტი რუსულ და ინგლისურენოვან ტექსტებში - **Times New Roman (Кириллица)**, ხოლო ქართულენოვან ტექსტში საჭიროა გამოვიყენოთ **AcadNusx.** შრიფტის ზომა – 12. სტატიას თან უნდა ახლდეს CD სტატიით.

2. სტატიის მოცულობა არ უნდა შეადგენდეს 10 გვერდზე ნაკლებს და 20 გვერდზე მეტს ლიტერატურის სიის და რეზიუმეების (ინგლისურ, რუსულ და ქართულ ენებზე) ჩათვლით.

3. სტატიაში საჭიროა გაშუქდეს: საკითხის აქტუალობა; კვლევის მიზანი; საკვლევი მასალა და გამოყენებული მეთოდები; მიღებული შედეგები და მათი განსჯა. ექსპერიმენტული ხასიათის სტატიების წარმოდგენისას ავტორებმა უნდა მიუთითონ საექსპერიმენტო ცხოველების სახეობა და რაოდენობა; გაუტკივარებისა და დაძინების მეთოდები (მწვავე ცდების პირობებში).

4. სტატიას თან უნდა ახლდეს რეზიუმე ინგლისურ, რუსულ და ქართულ ენებზე არანაკლებ ნახევარი გვერდის მოცულობისა (სათაურის, ავტორების, დაწესებულების მითითებით და უნდა შეიცავდეს შემდეგ განყოფილებებს: მიზანი, მასალა და მეთოდები, შედეგები და დასკვნები; ტექსტუალური ნაწილი არ უნდა იყოს 15 სტრიქონზე ნაკლები) და საკვანძო სიტყვების ჩამონათვალი (key words).

5. ცხრილები საჭიროა წარმოადგინოთ ნაბეჭდი სახით. ყველა ციფრული, შემაჯამებელი და პროცენტული მონაცემები უნდა შეესაბამებოდეს ტექსტში მოყვანილს.

6. ფოტოსურათები უნდა იყოს კონტრასტული; სურათები, ნახაზები, დიაგრამები - დასათაურებული, დანომრილი და სათანადო ადგილას ჩასმული. რენტგენოგრამების ფოტოასლები წარმოადგინეთ პოზიტიური გამოსახულებით **tiff** ფორმატში. მიკროფოტოსურათების წარწერებში საჭიროა მიუთითოთ ოკულარის ან ობიექტივის საშუალებით გადიდების ხარისხი, ანათალების შეღებვის ან იმპრეგნაციის მეთოდი და აღნიშნოთ სურათის ზედა და ქვედა ნაწილები.

7. სამამულო ავტორების გვარები სტატიაში აღინიშნება ინიციალების თანდართვით, უცხოურისა – უცხოური ტრანსკრიპციით.

8. სტატიას თან უნდა ახლდეს ავტორის მიერ გამოყენებული სამამულო და უცხოური შრომების ბიბლიოგრაფიული სია (ბოლო 5-8 წლის სიღრმით). ანბანური წყობით წარმოდგენილ ბიბლიოგრაფიულ სიაში მიუთითეთ ჯერ სამამულო, შემდეგ უცხოელი ავტორები (გვარი, ინიციალები, სტატიის სათაური, ჟურნალის დასახელება, გამოცემის ადგილი, წელი, ჟურნალის №, პირველი და ბოლო გვერდები). მონოგრაფიის შემთხვევაში მიუთითეთ გამოცემის წელი, ადგილი და გვერდების საერთო რაოდენობა. ტექსტში კვადრატულ ფჩხილებში უნდა მიუთითოთ ავტორის შესაბამისი N ლიტერატურის სიის მიხედვით. მიზანშეწონილია, რომ ციტირებული წყაროების უმეტესი ნაწილი იყოს 5-6 წლის სიღრმის.

9. სტატიას თან უნდა ახლდეს: ა) დაწესებულების ან სამეცნიერო ხელმძღვანელის წარდგინება, დამოწმებული ხელმოწერითა და ბეჭდით; ბ) დარგის სპეციალისტის დამოწმებული რეცენზია, რომელშიც მითითებული იქნება საკითხის აქტუალობა, მასალის საკმაობა, მეთოდის სანდოობა, შედეგების სამეცნიერო-პრაქტიკული მნიშვნელობა.

10. სტატიის ბოლოს საჭიროა ყველა ავტორის ხელმოწერა, რომელთა რაოდენობა არ უნდა აღემატებოდეს 5-ს.

11. რედაქცია იტოვებს უფლებას შეასწოროს სტატია. ტექსტზე მუშაობა და შეჯერება ხდება საავტორო ორიგინალის მიხედვით.

12. დაუშვებელია რედაქციაში ისეთი სტატიის წარდგენა, რომელიც დასაბეჭდად წარდგენილი იყო სხვა რედაქციაში ან გამოქვეყნებული იყო სხვა გამოცემებში.

აღნიშნული წესების დარღვევის შემთხვევაში სტატიები არ განიხილება.

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OSTEOSYNTHESIS OF CLAVICLE FRACTURES IN CHILDREN USING TITANIUM ELASTIC NAILS

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Abstract.

Objectives: Titanium Elastic Nail (TEN) fixation provides superior clinical and cosmetic outcomes with fewer complications compared to plating or Kirschner wire fixation in pediatric clavicle fractures.

Background:

Clavicle fractures account for about 10% of all paediatric fractures[1]. In displaced or unstable cases, surgical fixation is increasingly advocated. Titanium elastic nails (TEN) offer a minimally invasive intramedullary fixation option, but outcomes in children remain less widely documented.

Design: Retrospective cohort design study.

Setting: Single tertiary care center.

Patient Selection: Patients aged 10–18 years with acute clavicle fractures treated surgically between January 2021 and December 2024 were included. Patients were selected according to OTA/AO classification. Surgical technique selection was based on fracture characteristics: midshaft fractures with moderate displacement (15A-B types) were primarily treated with TEN fixation (n=48); severely comminuted or segmental fractures requiring anatomical plate fixation (n=11, 15C type); and simple transverse fractures amenable to K-wire fixation (n=13, 15A type). The observed difference in group sizes reflects the clinical distribution of fracture patterns and the preferential use of TEN for appropriate cases during the study period. Exclusion criteria included pathologic fractures, open fractures requiring complex reconstruction, and noncompliance with follow-up.

Outcomes: Primary outcome – radiographic union. Secondary outcomes – complications, functional outcomes, cosmetic satisfaction. Comparisons made between TEN, plating, and K-wire groups.

Data Collection: Extracted from electronic medical and radiographic records by two independent reviewers.

Methods:

This is a retrospective review of 72 pediatric patients (age 10–18) with clavicle fractures treated surgically at our center from 2021 to 2024. Fixation techniques included closed reduction with TEN (n = 48), open reduction with plating (n = 11), and intramedullary Kirschner wires (n = 13). We evaluated radiographic union, complications, functional outcomes, and cosmetic satisfaction.

Results:

Demographics and Baseline Data:

Seventy-two patients (58 males, 14 females; mean age 14 ± 4 years) were included. Mean follow-up was 12 months.

Radiographic Union and Healing:

Union achieved in 47/48 TEN, 9/11 plating, 12/13 K-wire cases. Mean union time 4 ± 1 weeks for TEN group. No statistically significant difference in union time across groups.

Complications:

TEN: skin irritation (n=1). Plating: non-union (n=1), plate deformation (n=1), refracture (n=1). K-wire: migration (n=3). No infections noted.

Functional Outcomes:

All patients achieved near-normal shoulder motion. Return to sport earliest in TEN group (~4 weeks).

Cosmetic Satisfaction:

TEN: minimal scarring (~1.5 cm incision) and excellent satisfaction. Plating and K-wire: visible scars and hardware prominence complaints.

Comparisons Between Groups:

Equivalent union rates observed, but TEN group had fewer complications and superior aesthetics.

Conclusions:

• Titanium Elastic Nails (TEN) provide effective, minimally invasive fixation for pediatric clavicle fractures.

• Faster recovery and better cosmetic outcomes than plating or K-wires.

• Low complication rate and high union success make TEN a preferred option in eligible pediatric cases.

Level of Evidence: III

Key words. Clavicle fracture, paediatric trauma, titanium elastic nails, intramedullary fixation, minimally invasive surgery.

Rationale.

Because Evidence of TEN use in Pediatric cavicle fractures is limited, there is a need for comperative clinical data evaluation its effectiveness, safety and cosmetic outcomes relative to plating and K-wires.

Hypothesis.

Titanium Elastic Nail (TEN) fixation results in comparable union rates but offers lower Complication rates, faster functional recovery, and superior cosmetic outcomes compared with plate fixation and k wire fixation in pediatric midshaft clavicle fractures.

Introduction.

Clavicle fractures are among the most common fractures in children, accounting for approximately 10% of all pediatric fractures [2]. They are responsible for 95% of trauma- related injuries diagnosed at birth [3,4,5].

In 87% of cases, the mechanism of injury involves a lateral fall onto the shoulder, while falls onto an outstretched arm are relatively uncommon [6]. Direct trauma, including road traffic accidents, is also a frequent cause [7]. Among these, 40% occur in cyclists, 17% in motorcyclists, and another 17% in pedestrians [8].

Clavicle fractures are usually isolated injuries, but in cases of high-energy trauma, they may be associated with complications such as pneumothorax or hemothorax. Due to the clavicle's proximity to vital structures - including the subclavian artery and the brachial plexus - there is a risk of injury to these structures during the fracture process.

The clavicle is an S-shaped tubular bone composed of a body and two ends, articulating laterally with the acromion at the acromioclavicular joint medially with the sternum at the sternoclavicular joint. Because of its subcutaneous location, the clavicle is most susceptible to fractures at the midshaft, where it is thinnest and lacks ligamentous attachments.

According to Allman's classification, clavicle fractures are divided into three groups based on anatomical location [9]:

- Group I: Fractures of the midshaft (most common).
- Group II: Fractures of the distal third.
- Group III: Fractures of the proximal third.

In children under 10 years of age, clavicle fractures are typically non-displaced. Fragment displacement becomes more common in older children [10]. Swelling of the arm and pain may develop within 24–48 hours of injury due to gravitational fluid accumulation, potentially leading to numbness, pain, swelling, discoloration of the fingers hand.

Diagnosis of clavicle fractures is usually straightforward [11]. Routine investigations include:

I. Anteroposterior (AP) X-ray

II. 45° cephalic tilt view X-ray – enhances evaluation of displacement and reduces overlap of the first rib and scapula.

In proximal or lateral fractures with joint involvement, CT imaging is recommended. For suspected pneumothorax, an expiratory chest X-ray should be performed. In cases of suspected neurovascular injury, arteriography, ultrasound, or CT angiography may be required.

Allman's classification was later modified by Neer, who described the following fracture types:

Type I: Minimally displaced fractures involving an intact coracoclavicular ligament. These are typically managed non-operatively.

Type II: The medial fragment is displaced downward due to traction by the sternocleidomastoid muscle, while the distal fragment is displaced upward. This fracture presents with outward deformity and carries a high risk of nonunion [12].

Type III: The fracture extends into the acromioclavicular joint but without significant displacement. These are usually managed conservatively; however, late degenerative changes may require distal clavicle resection.

Although various operative methods exist—including plate fixation and K-wire fixation—evidence supporting the use of Titanium Elastic Nails (TEN) for pediatric midshaft clavicle fractures remains limited. Few comparative studies have evaluated its clinical effectiveness, complication profile, and cosmetic outcomes relative to established techniques. This gap in the literature underscores the need for further investigation.

Therefore, the aim of this study is to compare TEN fixation with plate fixation and K-wire fixation in pediatric midshaft clavicle fractures. We hypothesize that TEN fixation achieves comparable union rates while providing lower complication rates, faster functional recovery, and superior cosmetic results.

Materials and Methods.

Study design & Patient Selection:

- **Design:** Retrospective cohort study.
- **Time frame:** January 2021 to December 2024.
- **Inclusion criteria:** Ages 10 to 18 years; acute clavicle fractures treated surgically; minimum follow-up of 12 months (see: Figure 1 and Figure 2).
- **Exclusion criteria:** Pathologic fractures, open fractures requiring complex reconstruction, noncompliance with follow-up.

Figure 1. *The clavicle fractures of Patient Ch.G., a 14-year-old, presented with a midshaft fracture of the right clavicle with displacement, before TEN fixation is shown.*

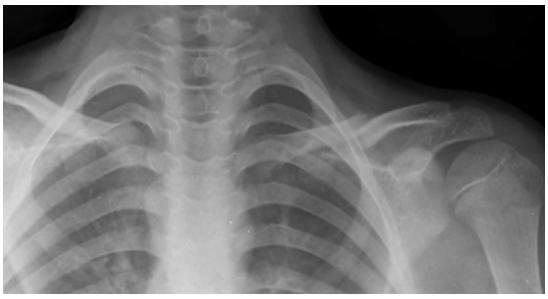

Figure 2. *Patient G.N., a 10-year-old, presented with a displaced midshaft fracture of the left clavicle, as shown in Figure 2 prior to TEN fixation.*

Figure 3. *Patient Ch.G., a 14-year-old, underwent intramedullary osteosynthesis of a right clavicle fracture using a titanium elastic nail.*

Figure 4. *Patient G.N., a 10-year-old, underwent intramedullary osteosynthesis of a left clavicle fracture using a titanium elastic nail.*

Table 1. *Demographics & Baseline Data.*

Group	Number of Patients	Mean Age	Sex (M/F)	Fracture Type
TEN	48	14 ± 4	38/10	15A–B
Plating	11	14 ± 4	9/2	15C
K-wire	13	14 ± 4	11/2	15A
TEN	48	14 ± 4	38/10	15A–B

Between 2021 and 2024, at our center, 72 patients aged 10 to 18 years were admitted with various types of clavicle fractures, all requiring surgical intervention. Among them, 58 were boys and 14 were girls. Fractures were right-sided in 34 patients left-sided in 38.

Treatment Arms:

• TEN group (n = 48): Closed reduction and intramedullary fixation using a single titanium elastic nail under fluoroscopic guidance. (See: Figure 3 and Figure 4.)

• Plating group (n = 11): Open reduction and internal fixation with plate & screws

• K-wire group (n = 13): Open reduction and intramedullary Kirschner wire fixation

Surgical Technique:

TEN

• Position: beach chair (semi-sitting)

• Approach: ~1–1.5 cm incision ~2 cm lateral to the sternal end

• Reduction: Using bone-holding forceps under fluoroscopy

• Nail insertion: A single TEN inserted via entry point at sternal end

• Closure: Layered, cosmetic skin suture, sterile dressing

Closed reduction of the fracture fragments is performed using pointed bone-holding forceps. Once anatomical reduction is achieved, intramedullary fixation is carried out using a single titanium elastic nail, inserted through an entry point previously created at the sternal end of the clavicle with a triangular retractor.

Following adequate hemostasis, the wound is closed in layers, and a cosmetic epidermal suture is placed on the skin. A sterile dressing is applied.

Closed reduction internal fixation of the fracture using a titanium elastic nail is performed under C-Arm guidance.

Postoperative Care & Follow-up:

• Immobilization: arm support, for ~1 week.

• Rehabilitation protocol: No limit to the range of motion since the day 1. Full activity resumed in 1 month.

• Follow-up schedule: ~ 4 weeks after the surgery.

• Outcome measures:

• Radiographic union: ~ 4 weeks to union, (bridging callus)

• Complications infection – 0 - non-union, 1 case of implant irritation, 0 - migration, reoperation – 0.

• Functional outcomes: Full range of motion, same strength as before Surgery.

• Cosmetic satisfaction: Scar - Approximately 1.5cm.

• Return to activity/sport: in ~4 weeks.

Results.

Radiographic Union & Healing:

• In the TEN group, union was achieved in 47/48 cases within a mean of 4 ± 1 weeks.

• Plating group: union in 9/11 cases by mean weeks

• K-wire group: union in 12/13 cases, delayed in one

Complications:

• TEN: minor complications: skin irritation n = 1

• Plating: non-union n=1, Plate deformation n=1, refracture n=1, Infection n=0.

• K-wire: migration n=3, pin tract infection n=0, reoperations n=0.

Functional Outcomes & Range of Motion:

• All patients regained near-normal full shoulder range of motion by last follow-up

• Comparison of degrees of flexion, abduction, external rotation among groups

• Time to full activity, return to sport

Cosmetic & Patient Satisfaction:

• In TEN group: minimal scarring, good contour, high cosmetic satisfaction scores

• In plating group: more extensive scar, occasional complaints of hardware prominence

• In K-wire group: pin tract scars, occasional skin irritation

Comparisons Between Groups:

• TEN vs plating: no significant difference in union time, but less soft tissue trauma, fewer complications.

• TEN vs K-wire: better stability, fewer hardware-related complications.

Discussion.

Summary of Current Study Results: TEN fixation showed high union rates, minimal complications, and faster recovery in pediatric clavicle fractures.

Summary of Relevant Literature: Existing reports describe good plating outcomes but greater soft-tissue disruption, while K-wires risk migration and infection. During the study period, K-wire fixation was utilized in selected cases due to considerations including lower implant cost, reduced procedural complexity compared to TEN, and limited availability of specialized elastic nail instrumentation at the institution during the earlier phase of the study. However, the observed migration rate in our K-wire cohort (3/13 cases, 23%) aligns with reported complications in the literature and contributed to the subsequent preferential adoption of TEN fixation for appropriate fracture patterns.

Comparison with Literature: Findings align with prior data favoring TEN for minimally invasive fixation and faster return to activity.

Limitations: Retrospective design, single-center scope, modest cohort size, and limited follow-up.

Take-Home Points and Conclusions: TEN fixation is reliable, cosmetically favorable, and minimally invasive, supporting its use in pediatric midshaft clavicle fractures.

Main Findings.

This study demonstrates that Titanium Elastic Nail (TEN) fixation is a safe, effective, and minimally invasive surgical technique for treating displaced clavicle fractures in children aged 10–18. Among the 72 paediatric cases evaluated, patients treated with TEN (n=48) experienced high union rates, minimal complications, and excellent cosmetic and functional outcomes. These results support TEN as a preferred option for midshaft clavicle fractures in the paediatric population.

Comparison with Literature:

The current literature reports good outcomes with plate fixation in paediatric clavicle fractures, but plating requires more extensive soft tissue dissection, which increases the risk of infection and scarring. Similarly, Kirschner wire (K-wire) fixation, while less invasive than plating, carries a higher risk of migration, infection, and often requires secondary removal.

In contrast, our results show that TEN fixation leads to superior functional outcomes, with a lower complication rate and reduced need for hardware removal compared to plating and K-wire fixation. Prior reports of TEN in adult clavicle fractures have shown comparable union rates and faster return to function, aligning with our findings in the paediatric population. However, literature on paediatric clavicle TEN use remains limited, and our study adds valuable clinical data supporting its efficacy in children.

Biomechanics:

TEN offers elastic, intramedullary fixation, which allows for dynamic axial stability and load-sharing across the fracture site. This differs from rigid plating, which may inhibit micro-movement needed for callus formation. By occupying the medullary canal and conforming to the natural S-shape of the clavicle, the nail provides three-point fixation, facilitating proper alignment while minimizing disruption to surrounding tissues. The technique also preserves the periosteal blood supply, supporting faster and more reliable bone healing.

Advantages of TEN in Paediatric Clavicle Fracture:

- Minimally invasive approach, resulting in smaller incisions and better cosmetic outcomes.
- Preservation of soft tissues and the periosteal blood supply, crucial for bone remodelling in children.
- Shorter hospital stays and quicker return to daily activities compared to plating.
- Lower hardware profile, which reduces irritation and often eliminates the need for a second surgery for removal.
- Favorable aesthetic results due to minimal scarring and less soft tissue disruption.

Clinical Implications & Indications:

TEN appears particularly suited for:

- Midshaft clavicle fractures in paediatric patients with moderate displacement and sufficient bone stock.
- Cases where soft tissue preservation and cosmetic outcome are priorities.
- Children and adolescents with low to moderate activity levels during the initial healing phase.

Plating may still be preferred in:

- Highly comminuted fractures
- Segmental injuries
- Fractures where anatomical alignment cannot be maintained intramedullary K-wire fixation can be reserved for:
- Simple, non-comminuted fractures
- Situations where TEN or plating is not feasible due to equipment or technical limitations.

Conclusion.

Intramedullary osteosynthesis using titanium elastic nails (TEN) is a promising surgical treatment for clavicle fractures in children. This minimally invasive technique is less traumatic, allows for faster recovery, and is particularly well-suited for the pediatric population. It is associated with minimal complications, with most risks related primarily to general anesthesia.

The method enables stable fracture fixation without the need for external immobilization, enhancing patient comfort during the recovery period. Additionally, aesthetic outcomes are favorable, with minimal soft tissue disruption and reduced scarring.

Ethical Approval and Consent.

This study was approved by the Ethics Committee of our Clinic. Informed consent was obtained from all patients or their legal guardians prior to surgical intervention use of anonymized clinical data.

Potential Conflicts of Interest.

None are declared

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