



Research Article

Patient and Family Satisfaction After Elastic Stable Intramedullary Nailing (ESIN) for Forearm Shaft Fractures in Childhood and Adolescence

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Abstract

Introduction: Elastic Stable Intramedullary Nailing (ESIN) has become the gold standard in the surgical treatment of diaphyseal fractures of long bones in children and adolescents. The results are generally considered excellent by the medical community, particularly for the forearm shaft. We investigated whether the families affected share this view and what socio-economic impacts this has had on them. **Materials and Methods:** We identified all patients of growth age from the surgical module of our department of the 2020-2024 cohorts who were treated with ESIN for a forearm shaft fracture. The families were sent a questionnaire with 13 questions regarding their satisfaction with the treatment. **Results:** 68 of the 186 families contacted participated in the questionnaire. 97.2% were satisfied or very satisfied with the treatment, and 89.8% would recommend the method to other parents. Over 50% of the children were pain-free after a maximum of 3 days, and almost three-quarters returned to school after a maximum of 2 weeks. More than half of the parents caring for the children had to be absent from work for less than a week. **Discussion:** Few studies have examined how parents and families assess standard methods in pediatric traumatology and the impact of injury and treatment on the family's life. These impacts may affect not only the injured child but also the support needs and potential loss of productivity and income for the parents. For elastic stable intramedullary nailing, we were able to generate data on this topic for the first time. This data shows that, in this case, the medical gold standard is also rated as very satisfactory by the parents, both in terms of the burden and the functional outcomes.

Keywords: Forearm shaft fractures; ESIN; Children; Family satisfaction; Socioeconomic effects

Introduction

Elastic Stable Intramedullary Nailing (ESIN) is currently the only osteosynthesis procedure specifically developed for pediatric and adolescent traumatology and is used almost exclusively in this age group. Developed in France in the 1980s, the first results for forearm shaft fractures were published by the research group led by Lascombes, Prevot, and Metaizeau [1].

The introduction of this new technique represented a significant advancement, particularly for the treatment of forearm shaft

fractures in children and adolescents. While Schmittenbecher et al. reported in 1991 on the immense number of complications associated with the non-operative treatment of forearm shaft fractures, especially redislocation rates after reduction of 60 percent and more [2], the same research group found a few years later that the application of the ESIN method for forearm shaft fractures consistently yields good results without generating a significant complication rate [3]. Since then, the procedure has become a standard, and its excellent results are undisputed in the scientific literature on pediatric traumatology [4-9].

However, in the enthusiasm surrounding the undoubtedly very good results from a medical perspective regarding the avoidance

of secondary dislocations, stability, fracture healing, and functional outcome, the subjective experience of the treatment by the young patients and their families could be overlooked. We therefore considered it necessary to also inquire about and evaluate their assessment of the treatment method, its social and, where applicable, socioeconomic impact, and the results, and potentially use this information as a basis for changes in the treatment process.

Materials and Methods

To investigate patient and family satisfaction after ESIN (Extended

Sanitary Induction) treatment for forearm shaft fractures, we designed a questionnaire with 13 questions about the method itself, its impact on the family's follow-up care of the affected children, and satisfaction with the treatment process (Table 1). The anonymous questionnaires, along with a cover letter explaining the purpose of the study, were mailed to the families and returned to the study team in a prepaid envelope. In accordance with the relevant ethics committee, returning the questionnaire was considered informed consent to participate in the study.

Were you satisfied with the information and explanation provided before the operation?	very satisfied rather satisfied indecisive rather unsatisfied unsatisfied
After approximately how many days was your child pain-free?	at day 1 day 2-3 day 4-6 1-2 weeks more than 2 weeks
Would you have liked additional plaster cast treatment after the operation?	Yes No
For what period of time did you have to be absent from your workplace due to childcare responsibilities?	less than 1 week 1-2 weeks 2-3 weeks 3-4 weeks more than 4 weeks
For what period of time did you have to rely on help from relatives/acquaintances/friends for childcare?	less than 1 week 1-2 weeks 2-3 weeks 3-4 weeks more than 4 weeks
After what period of time was your child able to return to kindergarten/school?	less than 1 week 1-2 weeks 2-3 weeks 3-4 weeks more than 4 weeks
Were you satisfied with the information and explanation regarding aftercare, including metal removal?	very satisfied rather satisfied indecisive rather unsatisfied unsatisfied
Were you satisfied with the outpatient procedure for metal removal?	very satisfied rather satisfied indecisive rather unsatisfied unsatisfied

Were you satisfied with the treatment method and the overall result?	very satisfied rather satisfied indecisive rather unsatisfied unsatisfied
Are you satisfied with the scarring on the injured arm?	very satisfied rather satisfied indecisive rather unsatisfied unsatisfied
Are you satisfied with the function of the injured arm?	very satisfied rather satisfied indecisive rather unsatisfied unsatisfied
Are there any remaining functional limitations in the injured arm?	regarding mobility during sports during writing at school still painful
Would you recommend this treatment method?	Yes No

Table 1: Family questionnaire for parents of children and adolescents after ESIN osteosynthesis for forearm shaft fractures. 13 questions with their answer options.

The patients were identified using the surgical module of the hospital information system at the University Hospital of Giessen. The search criteria were the OPS codes 5-790.25 and 5-790.27, or 5-791.g5 and 5-791.g8. These codes represent intramedullary nailing (ESIN) following closed or open reduction of fractures of the radial and ulnar shafts.

All cases of surgical ESIN application for forearm shaft fractures (one or both bones, ICD-10: S52.20, S52.30, and S52.4) from the years 2020–2024 were included. In addition to questionnaire analysis, epidemiological data such as age, sex, time to surgery, time to hardware removal, and complications during follow-up were collected.

Exclusion criteria were Monteggia fractures (ICD-10: S52.21), Galeazzi fractures (ICD-10: S52.31), and the use of intramedullary nailing for the reduction and reduction of radial neck fractures (ICD-10: S52.12).

The study included all cases of surgical application of ESIN for forearm shaft fractures (one or both bones, ICD-10: S52.20, S52.30, and S52.4) from the years 2020–2024.

Treatment Technique

In all cases, intramedullary nailing was performed ulnarly antegrade and radially retrograde. The nail diameter was chosen to be approximately 50% of the medullary canal diameter. All nails were pre-bent to stretch the interosseous membrane. Closed reduction was performed whenever possible. All fractures were treated postoperatively without a cast.

The Ethics Committee of Department 11, Human Medicine, of Justus Liebig University Giessen approved the project under file number 168/24 with a decision dated January 8, 2025.

Results

During the specified period, 186 cases of forearm shaft fractures treated surgically with ESIN were identified. Among the injured children and adolescents, 129 were male (69.4%) and 57 were female (30.6%). The mean age of the entire cohort was 7.3 years, but for boys it was almost a year higher at 7.4 years than for girls at 6.6 years.

68 of the 186 families contacted responded to the questionnaire (36.5%). 97.2% of the families were very satisfied or satisfied with the overall outcome of the treatment. 89.8% would recommend the treatment method to other families (Figure 1). 97.2% of respondents were also very satisfied or satisfied with the function of the injured arm. 84.0% reported no remaining functional limitations. 7.2% reported a remaining limitation of movement, and 2.8% each reported limitation in sports, writing, or school. 24.5% of families were dissatisfied or rather dissatisfied with the scarring.

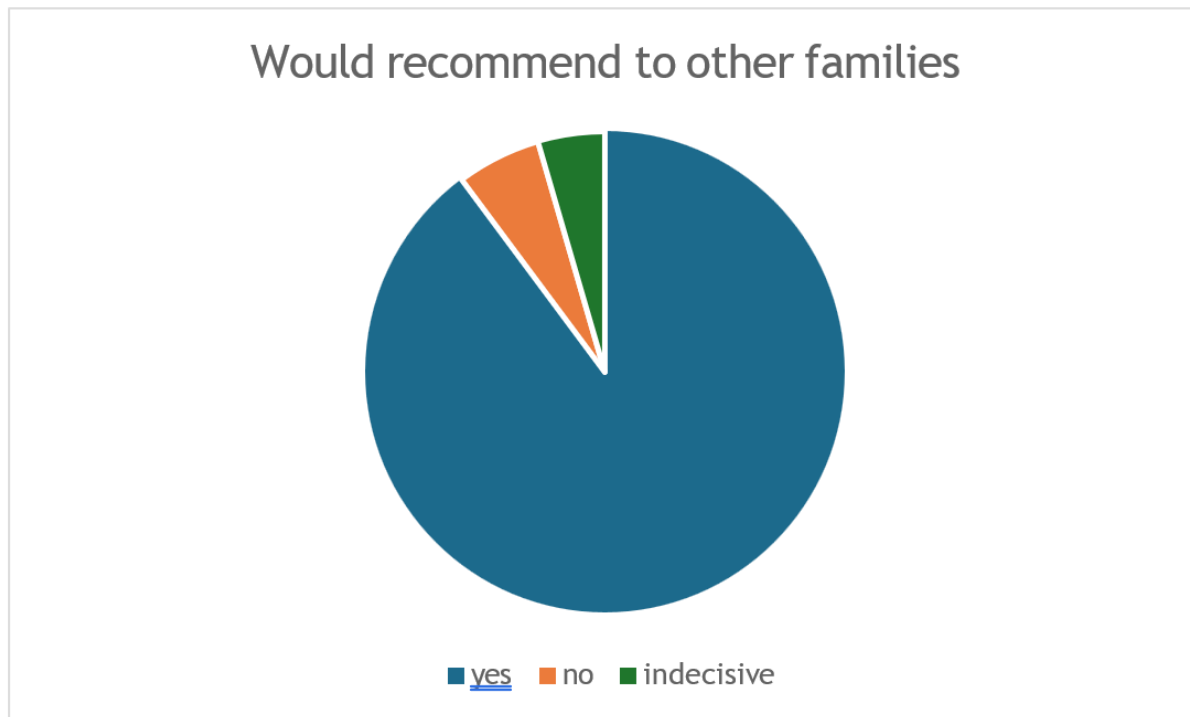


Figure 1: 89.8% of respondents would recommend the method to other parents, 5.7% would not.

13.2% would have preferred initial plaster cast treatment. 50.5% of the children were pain-free after 2-3 days, even without additional immobilization. Only 10.1% still complained of pain after 2 weeks (Figure 2). 43.6% of the young patients were absent from school or kindergarten for less than a week. However, 23.0% of the children and adolescents also stayed home for more than 2 weeks (Figure 3).

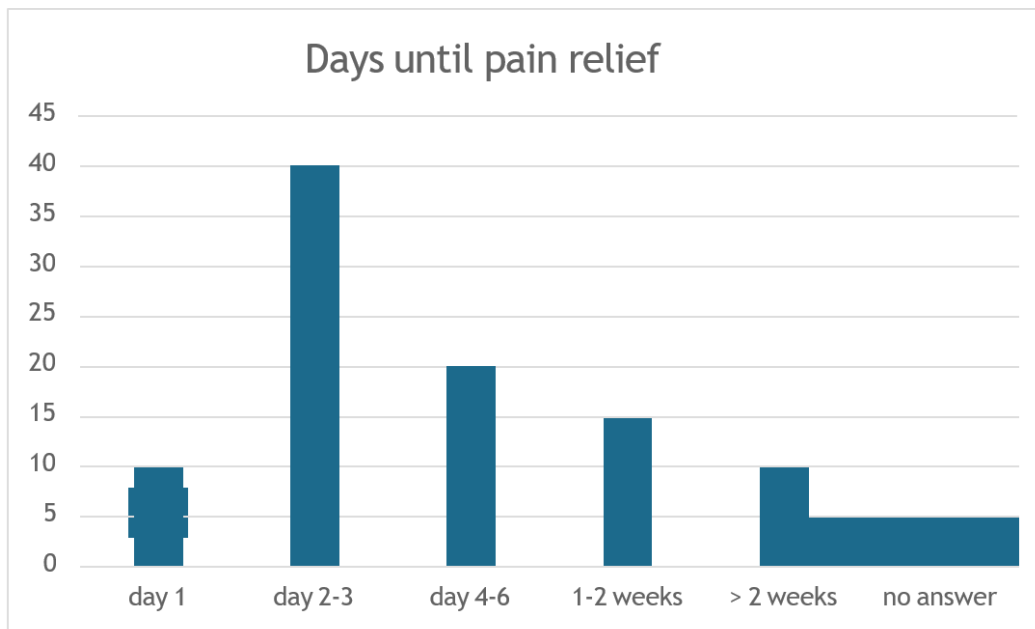


Figure 2: Time until pain relief as reported by the parents. Data in percent.

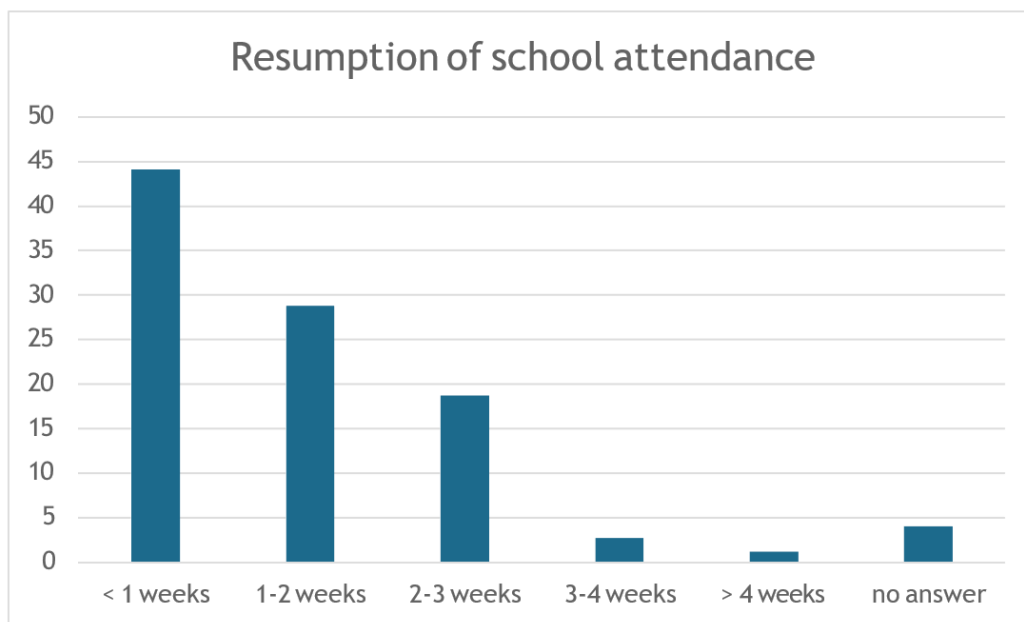


Figure 3: Time until return to school after ESIN osteosynthesis for forearm shaft fracture. Data in percent.

Regarding childcare during the primary treatment, 71% of families required help from relatives or friends for less than a week. Only 7.1% needed this for more than 2 weeks. 53.6% took parental leave for less than a week, but 10.1% took it for more than 2 weeks (Figure 4).



Figure 4: Duration of use of child sickness benefit. Data in percent.

94.1% felt well or very well informed about the surgery itself. 89.8% were very satisfied or satisfied with the information provided regarding aftercare and metal removal. 92.7% were very satisfied or satisfied with the outpatient metal removal procedure.

Discussion

Continuously surveying patients and their families about their experiences and satisfaction with treatment is one of the most important quality parameters of medical care. Such surveys are therefore an integral part of guideline development [10]. The relevance of feedback from parents and caregivers plays a particularly important role in pediatric medicine, as caring for sick children often entails even more significant changes in the daily lives of the families involved. Accordingly, there are a number of general standardized questionnaires on family satisfaction regarding sick children [11].

Few publications address the satisfaction of affected families with treatment methods for fractures of the upper extremities in children of growing age. Derksen et al. [12] investigated satisfaction with

swim casts in the treatment of distal radius fractures. They found higher satisfaction compared with the use of conventional support bandages without an increase in complications. Other research groups found high family satisfaction with the treatment of distal radius torus fractures using removable orthoses [13-15]. In an Indian study, parents of children with various types of forearm fractures were satisfied with the reduction of the injuries without anesthesia [16]. However, we reject such a procedure as not being suitable for children, at least under the medical conditions prevailing in Central Europe.

As early as 2000, Till et al. [3] surveyed the young patients themselves about their satisfaction with the outcome of their forearm shaft fracture treatment using ESIN. 91% rated the functional result as perfect, and 93% were satisfied with the overall result. However, in this group of 70 patients, the average age was much higher at 12.7 years than in our cohort at 7.3 years.

To our knowledge, a systematic, targeted, and explicit survey of families of children and adolescents after elastic stable

intramedullary nailing for forearm shaft fractures regarding their experience of the treatment process and their assessment of the results has not yet been conducted.

In clinical practice, it is often observed that elastic stable intramedullary nailing (ESIN) of a forearm shaft fracture is followed by additional immobilization for 1, 2, or even 6 weeks. However, early functional rehabilitation is an integral part of the method [1,5,9], and Kozlu et al. recently demonstrated [17] that early movement and use of the injured arm does not delay fracture healing. Schwarz et al. [18] even found a threefold increased complication rate in a group with postoperatively immobilized forearm fractures compared to those treated with standard cast-free treatment. Further studies confirm that additional immobilization is not indicated [19]. However, Klosinski et al. [20] conclude that two weeks of immobilization after ESIN has a positive effect on pain development. Given the duration of pain reported in our cohort, we cannot agree with this conclusion. The fact that more than 13% of families would have preferred additional postoperative immobilization should, in our view, be seen as an understandable need for protection, even for laypeople. This suggests a need for more intensive explanation and education.

Several research groups have demonstrated that elastic stable intramedullary nailing for femoral shaft fractures leads to significantly reduced pain compared to plate osteosynthesis [21,22]. Our own cohort confirms that postoperative pain following elastic stable intramedullary nailing of forearm shaft fractures is also mild and short-lived in the vast majority of cases. This is confirmed by most review articles [4,9,17,23].

There is no literature on the impact of caring for injured children on family life. Studies on the impact of caring for sick adults show that up to two-thirds of caregiver's experience work absences and reduced income [24, 25]. In the case of neuropaediatric diseases, more than 80% of affected parents report the need to reduce their working hours or experiencing recurring short-term absences [26]. Pediatric infectious diseases such as chickenpox also often lead to a significant loss of productivity for the parents providing care [27]. Although the injuries of our patients are considered less debilitating compared to the aforementioned diseases and only rarely result in long-term consequences, we were nevertheless able to demonstrate that families of children with surgically treated forearm shaft fractures still require temporary support from family members and friends for between one and four weeks. Parental absences from work are also not uncommon, but are mitigated in the German healthcare system by the possibility of child sickness benefits for up to 15 days per year [28]. In less differentiated healthcare systems, this can have serious socioeconomic consequences for families.

Limitations

A significant limitation is the fact that this is a single-center study. Therefore, the assessment of patients and their families is undoubtedly influenced not only by the standardized components of the method but also by the procedures customary at the conducting clinic. Any dissatisfaction with these procedures cannot, of course, be attributed to the method itself. Another limitation is the relatively small number of questionnaires received for analysis. During the study, we found that a considerable proportion of the mailed questionnaires did not reach their intended recipients at their original place of residence.

Conclusion

In the case of elastic stable intramedullary nailing (ESIN) for forearm shaft fractures in children and adolescents, the medical assessment of the method as a safe procedure with excellent functional outcomes is consistent with the assessment and satisfaction of the affected families. A prospective randomized controlled trial comparing conservative treatment and plate osteosynthesis of forearm shaft fractures in children and adolescents could statistically confirm the superiority of ESIN, but is not feasible due to the obvious advantages of the ESIN method.

Conflict of Interest: S. Hennes, C. Heiß, and R. Kraus declare that they have no conflict of interest.

This study was conducted in accordance with the guidelines for Good Clinical Practice and the ethical standards of the 1964 Declaration of Helsinki and its subsequent amendments.

The manuscript is based on results from the first author's dissertation at the Justus Liebig University Giessen entitled "Patient and family satisfaction after Elastic Stable Intramedullary Nailing (ESIN) in forearm shaft fractures in childhood and adolescence".

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