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REVIEW / PRACA POGLĄDOWA

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THE EVALUATION OF THE RESULTS OF SURGICAL TREATMENT OF FOREARM SHAFT FRACTURES IN CHILDREN USING ELASTIC INTRAMEDULLARY STABILIZATION

OCENA WYNIKÓW OPERACYJENGO LECZENIA ZŁAMAŃ TRZONÓW KOSCI PRZEDRAMIENIA U DZIECI I MŁODZIEŻY METODĄ ELASTYCZNEJ STABILIZACJI ŚRÓDSZPIKOWEJ

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Summary

The vast majority of fractures of the forearm bones in juveniles may be treated conservatively immobilization in a cast. However, in some cases, surgical treatment is indicated because of the large displacement of fracture instability. The purpose of our study was to evaluate the surgical treatment of fractures of the forearm bones in children using flexible method intramedullary stabilization of patients on the basis of our branch.

Material and methods:

In years from 2002 – to 2011 129 patients were surgically treated because of forearm fractures. A group of 41 patients (32%) were studied in our branch. They have earlier had applied for phone call. Clinical assessment was given in the range of flexion and extension of wrist and elbow and forearm rotation range. It was investigated shake hands and subjective pain. These results were evaluated using the modified Fernandez – scale. The surgery was performed under general anesthesia. After setting fractures, the camera hood with a small skin incision was introduced into the marrow cavity of flexible steel wire stabilizing factions. The end of the wire after bending left under skin.

Results:

It was reported: 95,1% (n=38) were very good results and 4,9% (n=2) were good results and lack of medium and poor treatment. The patients in the study group, who suffered the most was the common limitation of forearm rotation (36,6%, n=15). One patient experienced a significant complication in the form of damage to the radial nerve dorsal knobs. All patients were satisfied with the outcome of treatment in their subjective opinion.

Conlusions:

In our opinion, flexible intramedullary stabilization of fractures of the forearm bones in children and adolescents is the method gives very good results of the treatment, minimally invasive and technically simple.

Streszczenie

Wstęp. Znaczna większość złamań trzonów kości przedramienia u nieletnich może być z powodzeniem leczona zachowawczo unieruchomieniem w opatrunku gipsowym. Jednak w niektórych przypadkach wskazane jest leczenie operacyjne ze względu na duże przemieszczenie lub niestabilność złamania. Celem naszej pracy była ocena operacyjnego leczenia złamań trzonów kości przedramienia u dzieci metodą elastycznej stabilizacji śródszpikowej, na podstawie pacjentów naszego oddziału.

Materiał i metoda. W latach 2002 – 2011 leczono operacyjnie z powodu złamania przedramienia 129 pacjentów. Przebadano grupę 41 pacjentów (32%), którzy zgłosili się na telefoniczne zaproszenie. Ocenie klinicznej poddano zakres zgięcia i wyprostu nadgarstka i łokcia oraz zakres rotacji przedramienia. Badano siłę uścisku dłoni oraz odnotowywano subiektywne dolegliwości bólowe. Wyniki te zostały ocenione za pomocą zmodyfikowanej skali Fernandeza. Zabieg operacyjny przeprowadzano w znieczuleniu ogólnym. Po

nastawieniu złamania na aparacie wyciągowym, z niewielkiego cięcia skórnego wprowadzano do jamy szpikowej elastyczny stalowy drut stabilizujący odłamy. Koniec drutu po zagięciu pozostawiano pod skórą.

Wyniki. Odnotowano 95.1% (n=38) bardzo dobrych wyników i 4.9% (n=2) dobrych, brak średnich oraz złych wyników leczenia. W badanej grupie pacjentów najczęściej stwierdzanym ubytkiem zakresu ruchomości przedramienia było ograniczenie rotacji przedramienia 36,6% (n=15). U jednego pacjenta wystąpiło znaczące powikłanie pod postacią uszkodzenia gałązki grzbietowej nerwu promieniowego. Wszyscy pacjenci byli zadowoleni z wyniku leczenia w swojej subiektywnej opinii.

Wnioski. W naszej opinii, elastyczna stabilizacja śródszpikowa złamań trzonów kości przedramienia u dzieci i młodzieży jest metodą zapewniającą bardzo dobre wyniki leczenia, małoinwazyjną oraz prostą technicznie.

Key words: fractures of forearm bones, intramedullary stabilization, fractures in children

Słowa kluczowe: Złamania trzonów kości przedramienia, zespolenie śródszpikowe, złamania u dzieci,

MATERIAL AND METHODS:

During the period from 2002 to 2011, 129 patients were surgically treated because of forearm fractures. A group of 41 patients (32%) were studied at our ward. They were invited to take part in the study via phone. Clinical assessment was given in the range of flexion and extension of wrist and elbow and forearm rotation range. Shake hands and subjective pain were investigated. These results were evaluated using the modified Fernandez – scale. The surgery was performed under general anaesthesia. After setting fractures, the camera hood with a small skin incision was introduced into the marrow cavity of flexible steel wire stabilizing factions. The end of the bended wire was left under skin.

RESULTS:

It was reported: 95.1% (n=38) percent obtained very good results and 4.9% (n=2) - good results and lack of medium and poor treatment. The patients in the study group, who suffered the most, were the common limitation of forearm rotation (36.6%, n=15). One patient experienced a significant complication in the form of damage to the radial nerve dorsal knobs. All patients were satisfied with the outcome of treatment in their subjective opinion.

APPLICATIONS:

In our opinion, flexible intramedullary stabilization of fractures of the forearm bones in children and adolescents is the method that gives very good results of the treatment, minimally invasive and technically simple.

ADMISSION:

The bone forearm fractures in children and adolescents constitute 45% (percent) of all fractures in this age group, 62% (percent) of upper limb fractures. Epiphysis and metaphysical fractures of further fractures constitute the largest group (75%), while fractures of vertebral bones of the forearm only 6-10% (percent) [3, 4, 5], 15-18% [1, 2]. The vast majority of these fractures (more than 90 %) require only immobilization in a cast or a closed setting without prior [3, 5].

In contrast to adults, we can accept some imperfections setting fractures in children and young people. Mainly in terms of angular bend bone.
In the age group above 9 years old a bending of 15 degrees is accepted, but below 9 years old - already only 10 degrees [6]. Adult patients with displaced fractures of the forearm bones require anatomical reposition and stabilize the ruthless.

Most fractures in children are easy to be treated, but secondary movements cannot be forgotten. They occur in the case of 11% (percent) of fractures treated by the cast and require primary or secondary closed reduction.

Indications for surgical treatment of bone forearm fractures are potentially unstable fractures, fractures with a large displacement of bone fragments and soft tissue interposition, secondary displacement, open fractures and fractures in patients with polytrauma.

Both bones of forearm fracture, where the bone fracture of the radial gap lies proximal to the fracture of the ulna, is considered an unstable fracture. The most common method of surgical treatment is to stabilize the intramedullary. It is an easy, not invasive and inexpensive method that rarely requires bloody setting fractures.

Intramedullary stabilization is alternative to a bloody reposition and a wide access to the stabilization of fractures with metal plate. This method has many supporters, but it is most often used in youth. Many authors agree that both methods give similar results in the treatment of these fractures [9, 10, 11].

Disorders are rarely described union forearm bones in children and adolescents after surgery.
However, we found two reports of disorders union for the treatment of intramedullary stabilization [3, 12].

In our work, we evaluated patients treated in our department due to vertebral bone forearm fractures who had been operated with intramedullary stabilization method with flexible wires.

RESULTS:

Operative treatment was required by 129 patients (39.4%, n=129) hospitalized with fractures of vertebral bones of the forearm.

The most typical qualification for the operation was unacceptable setting fracture fragments (67.5%, n=87 patients). The indication for intramedullary stabilization was also secondary fracture displacement and re – vertebral bone forearm fractures.
13.9% (n=18) and 3.1% (n=4) (table number 2).

In 16% of children (15.5%, n=20) experienced open fracture which was classified as a grade 1 (I) according to the classification of Gustilo and Anderson. In the group of patients treated surgically in the majority were boys (79%, n=102), then - girls (21%, n=27). The average age was 12.1 years old (age from 4 years old – to 17 years old) for boys, and among girls the average age was 9.7 years old (age from 3 years old – to 15 years old). 41 patients volunteered for the study. During the surgery there were 12 children below 10 years old, 29 children were above 10 years old. The incidence of injuries depending on the gender by the age of our patients is demonstrated in Table 1. The incidence of injuries, depending on the months is shown in Table 2

The largest number of fractures took place in May, July and August. Among all patients with vertebral fractures majority had limb bones left forearm fracture (63.6%, n=82). The most common fractures were both bones of the forearm (84.5%, n=109). 88 intramedullary stabilization of both bones of the forearm were performed.

If the stability of one bone obtained a very good set of fragments, the second anatomises was not performed (Table 3). The stabilization of the single bone was performed in 41 cases, the bones of the radius (n=27) and the ulna (n=14).
The open attitude made for 17.1% (n=22) of fractures.

The most common indication for reposition was soft tissue interposition or the necessity of the implementation of recanalization of the medullary canal in cases of re – fracture of the bone.

The most common place of fracture of shaft radius and ulna was their one-third (1/3) central (table number 4). When comparing the morphology of fracture we observed that radical bone fractures transversely more often than ulna (Table5). Patients were qualified for removal of anatomises after bone union. The Adhesion was assessed on the basis of X-ray pictures. The average hold time stability was 6 or 7 months (from 1 – to 17 months). The reason for earlier removal of the anatomises was reactive bursitis of introduction of wire and wire perforation of the skin (7.3%, n=3). In the study group of the patients the most common loss of range of motion of a broken forearm in the past was to limit the rotation of the forearm (36.6%, n=15).

. The correct range of forearm rotation presented 63/4%, (n=26) of patients, in this group test result of rotation 160°-180° degrees were included.

The slight limitation of rotation was investigated in 24.4 % (n=10) of patients with a score of rotation of 140°-159° degrees, moderate 120°-139° degrees and significant – is above 120° degrees, respectively 4.9% (percent) (n=2) and 7.3% (n=3) of the patients. In the group – 17% (percent, n=7) respondents reported chronic pain in the forearm. One patient experienced weakness grip strength. Three different types of complications were observed. The most important of them are damaged twigs dorsal radial nerve in one patient.

In one case, there were a perforation of the skin through the wire at the point of entry into the ulna, and the second case occurred elbow bursitis. The results were evaluated using a modified Fernandez scale (table number 1). 95.1% (n=38) percent reported very good results and 4.9% (percent, n=2) good results, and there was lack of medium and bad results of the treatment.

DISCUSSION:

Vertebral bone forearm fractures in children and adolescents are fractures that can be treated with simple, technical methods.

Despite the fact that we often encounter children with strongly deformed forearms after the break, most of them only require a closed setting and plaster immobilization. In about 18% of cases secondary instability occurs, despite proper fracture immobilization in a cast.

In our study, the rate was 13.9% and we have described many methods of surgical treatment. Intramedullary stabilization method is based on the technique of intramedullary fracture of the third point of support bone. This effect is achieved by means of flexible steel wire, Kirschner wires, Rush rods or flexible titanium wires (TEN).

Another common method of stabilization is an assembly using metal plates. You should not forget about the external stabilizers that we are sometimes forced to use in case of large soft tissue damage. The most commonly used are intramedullary stabilization and using metal plates. We compared the results of functional and radiological fusion, a lot of studies evaluate them similarly [9, 10, 11]. Most authors emphasize the advantage of intramedullary fixation methods of anastomosis shallow [16, 17].

Its benefits are: less severe traumatization, soft tissue stabilization and removal of the plate and lack of interference at bone healing.

Here are mentioned non-medical benefits such as: low cost methods for a short time surgery and cosmetic reasons. The doctor often faces the dilemma of accepting disorders while setting fractures. It is difficult to determine the permissible limit of angulation and fracture fragments shift, remembering the ability of the bone remodelling.

We know that growing bones possess the ability and they depend on several factors, mainly the child's age and location of the fracture.

The bend dorsal and volar distal radius have a long rebuilding because they are located near the main growth cartilage and the joint, which is in the axis of corners. The further from the distal forearm bone cartilage growth, the smaller the potential described.

Some books say that the rotational disorder of long bones does not undergo reconstruction with bone growth in length.

Johari et al. point out the right angle bends rebuilding the cartilage surrounding the distal forearm bone growth in children under 15 years of age, while in the case of fractures of the bones of a similar ability to observe up to 10 years old children.

Choosing the method of intramedullary fixation should be decided whether the bone fracture of forearm stabilize both. Many authors describe a single stabilization of vertebral fractures of both bones of forearm [20, 21].

Westacott et al. conclude that the stabilization of one or both bones of the forearm produces similar clinical outcomes. Unstable condition of leaving the second broken bone is the entire attitude and his durability confirmed intraoperatively.

If you decide on stabilization of one bone, it must be remembered that we can expect the isolated fusion of the bones of the radial with better results [21]. Setting of fractures and its durability is more difficult in the case of fractures in the proximal part of the vertebral. The reason is the leading cause muscle interposition in the fracture gap.

It makes the biggest difficulty when the gap radial bone fracture is located more proximal to the fracture of the ulna. In such cases, we are forced to perform an open and bloody reposition.

In the literature the high rate of such interventions is described.
Mann et al. report the 7.4% [22], while Yung et al. - 26% of the cases which required open reduction.
In our study it was 17.1%

Like Altay et al. we are of the opinion that little access over the fracture gap is less traumatic for soft tissue than multiple attempts a closed setting [3].

Despite the intramedullary fixation of forearm fractures vertebral bones in each case we assume an additional fixation rails hand – arm plaster.

The operating anastomosis connection method of treatment of plaster has many followers among the authors.

Quidway does not recommend this method and allows an earlier motion. This is considered a further advantage of this method of fixation. In our opinion, immobilization in a cast hand – shoulder prevents rotational movement and has analgesic. The significant correlation was observed between the peak period starting traumas and sexual maturation in girls and boys. An average, girls begin maturing faster than boys (about 2 years earlier).

Among the 129 children treated surgically for vertebral bone forearm fractures, one significant complication in the form of damage to the superficial radial nerve twigs was observed. It should be added that there had happened while removing anastomosis.

Fernandez et al. observed that 2.7% (n=15) of cases of a similar nerve injury occurred in 7 children while removing the material.

We obtained 95.1 % of very good results of surgical treatment, similarly to Lascombes et al. and Altay et al. in whose results were 92% [15] and 96%, respectively [3].

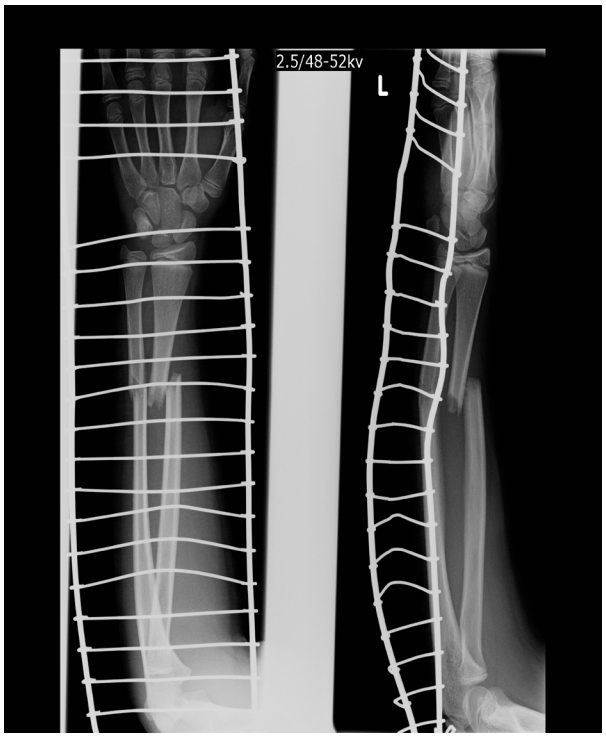
APPLICATIONS:

Flexible intramedullary stabilization of fractures of the forearm bones in children and adolescents is our method of choice. Using this method in our small patients, we obtained 95.1 % of very good results of treatment.

Intramedullary stabilization of our method is mostly bone fractures in children requiring surgery.

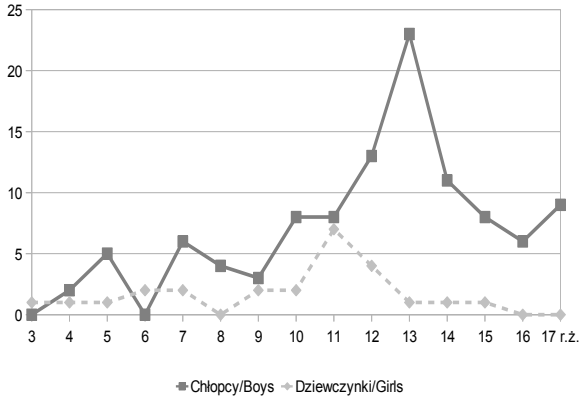
Zdjęcie 1. *Ułożenie przedramienia na aparacie wyciągowym.*

Zdjęcie 2. *Instrumentarium niezbędne do stabilizacji śródszpikowej.*

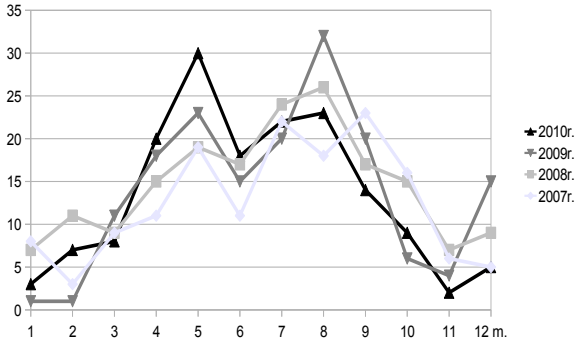


Zdjęcie 3. *Radiogram złamanego przedramienia przed zabiegiem.*

Zdjęcie 4. *Radiogram złamanego przedramienia po zabiegu stabilizacji.*



Wykres 1. *Ilość urazów w zależności od wieku dziecka.*
Number of injures depending on the age of the child.



Wykres 2. *Częstość występowania urazów w zależności od miesięcy.*
The incidence of injuries according months.

Zakres rotacji przedramienia Range of rotation in Forearm	160-180° 140-159° 120-139° <120°	4 pkt. 3 pkt. 2 pkt. 1 pkt.
Zakres ruchomości w łokciu Range of motion in Elbow	>140° 120-140° 100-119° <100°	4 pkt. 3 pkt. 2 pkt. 1 pkt.
Zakres ruchomości w nadgarstku Range of motion in Wrist	130-150° 100-129° 80-99° <80°	4 pkt. 3 pkt. 2 pkt. 1 pkt.
Ból przedramienia Pain in Forearm	Brak/Lack Łagodny/Mild Umiarkowany/Moderate Silny/Severe	4 pkt. 3 pkt. 2 pkt. 1 pkt.

Tabela 1. *Zmodyfikowana skala Fernandeza.*
Modified Fernandez's scale.

Wskazania Indications	% przypadków (n=129) % cases (n=129)
Pierwotna kwalifikacja Primary indications	67,5 (n=87)
Otwarte złamania Open fracture	15,5 (n=20)
Wtórne przemieszczenia Secondary displacement	13,9 (n=18)
Ponowne złamania Refracture	3,1 (n=4)

Tabela 2. *Wskazania do leczenia operacyjnego.*
Indications for surgery.

Kość Bone	% złamań (n=129) % of fractures (n=129)	% stabilizacji (n=129) % of stabilization (n=129)
Obie kości Both bones	84,5 (n=109)	68,2 (n=88)
Kość promieniowa Radius	11,6 (n=15)	20,9 (n=27)
Kość łokciowa Ulna	3,9 (n=5)	10,9 (n=14)

Tabela 3. *Rodzaj złamanej kości przedramienia oraz rodzaj stabilizacji.*
Type the broken bones of the forearm and the kind of stability.

Kość Bone	1/3 bliższa 1/3 proximal	1/3 środkowa 1/3 middle	1/3 dalsza 1/3 distal
Kość promieniowa Radius	5,60%	75,00%	19,40%
Kość łokciowa Ulna	2,00%	83,00%	15,00%

Tabela 4. *Miejsce złamania.*
The fracture site.

Kość Bone	Poprzeczna Transverse	Skośna Oblique
Kość promieniowa Radius	83,50%	16,50%
Kosć łokciowa Ulna	53,30%	46,70%

Tabela 5. Morfologia szczeliny złamania kości przedramienia.
Morphology of forearm fracture gap.

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