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5th Metatarsal Jones Fracture – To Treat Conservatively, or Surgically Using Headless Double-Threaded Herbert Screw?

Jonesova zlomenina 5. metatarzu – léčit konzervativně nebo chirurgicky bezhlavičkovým dvouzávitovým Herbertovým šroubem?

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ABSTRACT

PURPOSE OF THE STUDY

Fifth metatarsal fractures, in particular so-called Jones fractures, are relatively common injuries both in the general population and athletes. Although discussions about whether the surgical or conservative solution should be preferred are ongoing for decades, there is no clear consensus. Here, we aimed to prospectively compare the results of osteosynthesis using the Herbert screw with the conservative solution in patients from our department.

MATERIAL AND METHODS

Patients 18–50 years presenting to our department with Jones fracture and meeting further inclusion/exclusion criteria were offered participation in the study. Those willing to participate signed informed consent and were randomized by flipping the coin into surgically and conservatively treated groups. After six and twelve weeks, X-ray was performed in each patient and AOFAS score was determined. Conservatively treated patients who showed no signs of healing and whose AOFAS was below 80 after six weeks were offered surgery again.

RESULTS

Of 24 patients in total, 15 were assigned to the surgically treated group and nine were treated conservatively. After six weeks, AOFAS score of all but two patients (86%) in the surgically treated group ranged between 97 and 100, while this score exceeded 90 points only in three patients (33%) from the conservatively treated group. On X-ray, successful healing after six weeks was observed in seven patients (47%) from the surgically treated group but in none of the patients from the conservatively treated group. Three out of five patients in the conservative group whose AOFAS was below 80 after six weeks opted for surgery at that time and all improved significantly by the twelfth week.

DISCUSSION

Although studies on surgical treatment of Jones fracture using various screws or plates are not rare, we present an uncommon method of surgical treatment of this injury – the use of the Herbert screw. The results of this method are excellent and even on a relatively small sample yielded statistically significantly better results than conservative treatment. Moreover, the surgical treatment facilitated early loading of the injured limb, which allows an earlier return of the patients to normal life.

CONCLUSIONS

Osteosynthesis using Herbert screw in Jones fracture yielded significantly better results than conservative treatment.

Key words: Jones fracture, AOFAS, Herbert screw, 5th metatarsal fracture, surgical treatment.

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INTRODUCTION

The Jones fracture is a transverse fracture of the fifth metatarsal without significant dislocation in the junction of diaphysis and metaphysis. This fracture is characterized by minimal swelling, absence of hematoma and prolonged healing, and often develops after minimal stress.

The classification of fractures in the region of the proximal part of the fifth metatarsal remains controversial (17). Some authors fundamentally distinguish the so-called true (or real) Jones fracture from stress fractures (stress fracture, fatigue fractures) of the proximal fifth metatarsal diaphysis.

The proximal fifth metatarsal fracture (PFMF) can be treated surgically or conservatively. For conservative therapy, a full non-weight-bearing plaster cast or a full non-weight-bearing plastic orthosis are applied; alternatively, a weight-bearing orthosis can be used but if this option is selected, the patient is instructed to limit the weight put on the limb for six-eight weeks (4). The advantage of the conservative solution lies in the absence of surgery as such, the disadvantages include the long-term fixation and the associated problems, such as the risk of deep vein thrombosis (DVT), long-term rehabilitation and convalescence. Also, the rate of treatment failure is high.

Intramedullary screw fixation or tension loop osteosynthesis are the most common surgical techniques used in the treatment of PFMF. Typically, lag screws are used for osteosynthesis of this fracture; however, others suggest spongioplasty or cortico-cancellous graft to be a method of choice for these fractures (2). The advantage of the surgical solution lies in stable osteosynthesis, which allows earlier loading, rehabilitation and recovery. Also, the primary healing success rate is reported to be greater (19).

In our department, we started with surgical treatment of Jones fracture in 1998; since the beginning, we have been using two-threaded headless screws (Herbert screws) as this method is mini-invasive, the entire implant is placed inside the bone so no extraction is typically necessary, and the internal fixation provides sufficient compression of the fragments while also minimizing the shearing forces on the fracture (Fig. 1).

Still, we have used both conservative and surgical methods in our department. Over time, however, we noted a large number of complications in terms of delayed healing during conservative treatment. Therefore, we decided to perform a prospective randomized trial comparing the success of the conservative treatment (group C) to that of the surgical treatment (group S) in terms of (i) signs of healing on X-ray after six and twelve weeks from the beginning of treatment (ii) number of fully healed patients in both groups after twelve weeks.

Fig. 1. A Jones fracture after osteosynthesis with a two-threaded headless screw.

MATERIAL AND METHODS

Patient group, randomization and ethical statement

All procedures performed in studies involving human participants were in accordance with the ethical standards and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. The study was also registered in the clinicaltrials.gov database, under the ID: NCT04037540. The study was approved by the local Ethics Committee.

All patients who were treated for Jones fracture at the Department of Trauma Surgery of the University Hospital Ostrava over a six-year period meeting inclusion and exclusion criteria were offered participation. Patients with co-morbidities such as diabetes mellitus, chronic renal insufficiency, and osteopathy were excluded, as well as those in whom the Jones fracture was part of a multiple injury, patients with a personal history of 5th metatarsal injury and patients outside the age range of 18–50 years. In addition, patients whose mechanism of the injury was unknown (i.e., in whom the fracture might have been of older date) were also excluded, as well as patients with injuries older than one week at the time of diagnosis and treatment initiation.

The patients who agreed with inclusion in the study and signed informed consent were randomized into groups S (surgical solution) and C (conservative solution) by flipping the coin.

Fig. 2. Insertion of the Herbert screw along a guidewire.

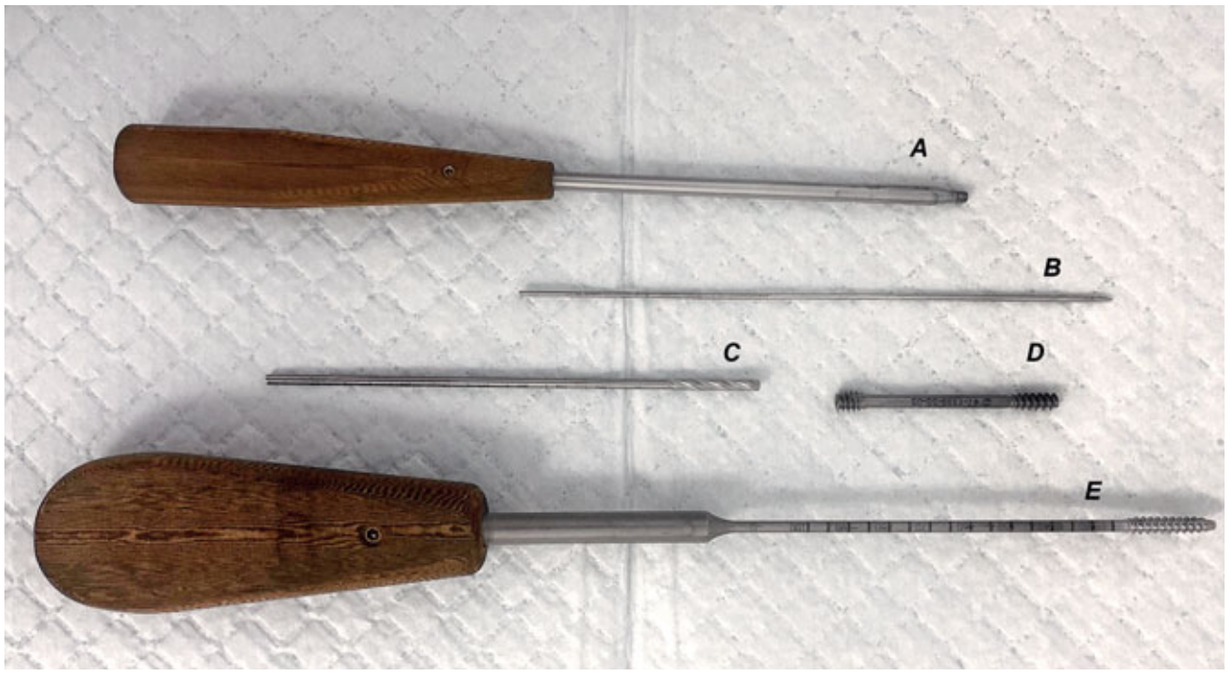

Fig. 3. Instrumentation for the 5th metatarsal osteosynthesis using the Herbert screw: A – screwdriver, B – guide wire, C – cannulated drill bit, D – Herbert screw 4.5x55 mm, E – distal thread cutter.

Treatment

Patients from the C group were conservatively treated using the OR15 orthosis (Walker orthosis) with a regime of no limb loading. Patients were given prophylaxis against DVT and allowed to remove the orthosis for hygiene.

Surgical treatment (Group S) was performed in the operating room under general or regional anesthesia, with the patient lying on the contralateral side. Above the base of the fifth metatarsal, a 1 cm long incision was made for guidewire insertion through both fragments. Using the guidewire, a channel was drilled, prepared for placement of the Herbert screw and the screw was inserted (see Fig. 2, 3). The wound was closed and a bandage was applied; after the post-operative pain subsided, the patient was allowed to load the limb according to pain tolerance.

Follow-up

A follow-up X-ray in two projections was always taken the day after the surgery (or initiation of the conservative treatment) and at intervals of 6 and twelve weeks after the start of the treatment. During these follow-ups, subjective clinical outcome was also evaluated using the AOFAS score (Table 1), which is widely used for the evaluation of foot injuries (1, 5).

The monitored parameters included healing status based on X-ray at six and twelve weeks (healed/not healed), AOFAS scores at six and twelve weeks, the number of necessary reoperations and occurrence of possible complications. X-ray signs of healing were defined as ossification of the fracture line and the presence of a callus around the fracture line.

The AOFAS questionnaire was always filled in by the patient during the sixth and twelfth week follow-up. The attending physician was always present for possible questions. Conservatively treated patients whose AOFAS score was below 80 after six weeks were offered conversion to surgical treatment.

The following serious conditions were considered complications: osteosynthesis failure, serious infection such as osteomyelitis or thrombophlebitis, and deep vein thrombosis with/out embolism.

Statistics

Numerical variables are presented using median, minimum and maximum, categorical variables as absolute and relative frequencies (%). The Mann-Whitney test or the Fisher's exact test were used for the assessment of between-group differences. The significance level was set to 0.05 and the statistical analysis was performed using R software (version 4.2.1).

RESULTS

In total, 24 patients with acute Jones fractures were included in the study, of which 15 were randomly assigned to the surgically treated group and nine to the conservatively treated group. The age and sex distribution are shown in Table 1.

After six weeks, X-ray showed signs of successful healing in seven patients (47%) from the surgically treated group but in none of the patients from the conservatively treated group. Even more importantly, the AOFAS score of all but two (86%) patients in the surgically treated group ranged between 97 and 100 while

Table 1. Sex and age distribution of the study group and the number of conversions to surgical treatment or reoperations, respectively

	Median (Min; Max) or n (%)[a]		p
	Conservative (n = 9)	Surgical (n = 15)	
Sex (male)	8 (89%)	12 (80%)	>0.999[b]
Age (years)	32 (19; 46)	27 (18; 40)	0.128[c]

[a] The median and the range (minimum and maximum) or the absolute and relative frequency in percentages.
[b] The p-value of the Fisher's exact test.
[c] The p-value of the Mann-Whitney test.

Table 2. Results of conservative and surgical treatment (with Herbert screw) at six weeks

	Median (Min; Max) or n (%)[a]		p
	Conservative (n = 9)	Surgical (n = 15)	
AOFAS	79 (56; 97)	100 (79; 100)	<0.001[b]
X-ray (healed)	0 (0%)	7 (47%)	0.022[c]
Conversion to surgical treatment/reoperation	3 (33%)	0 (0%)	

[a] The median and range (minimum and maximum) or the absolute and relative frequency in percentages.
[b] The p-value of the Mann-Whitney test.
[c] The p-value of the Fisher's exact test.

this score exceeded 90 points only in three patients (33%) from the conservatively treated group after six weeks. After twelve weeks, all patients from the surgically treated group had an AOFAS of 100.

Of the five patients from the conservatively treated group whose AOFAS score was below 80 after six weeks, three opted for conversion to surgery and after additional six weeks, their AOFAS scores improved from 56 to 84, from 75 to 100 and from 78 to 97, respectively. The remaining two patients were treated conservatively for additional six weeks, after which their AOFAS scores improved from 77 to 100 and from 79 to 87, respectively.

The results of X-ray imaging after twelve weeks correspond to those of the subjective evaluation by AOFAS score. Only two patients (13%) from the surgically treated group were not fully healed after twelve weeks according to the X-ray; still, neither of them had any clinical problems, with an AOFAS score of 100 in all cases in the surgically treated group. In the conservatively treated group, five out of six patients (83%) who were not converted to surgery also fully healed within twelve weeks.

The differences in healing between the conservatively and surgically treated groups were significant according to both X-ray and the AOFAS score at six weeks, with the surgical solution achieving better results in all parameters (Table 2).

No complications were recorded in the surgically treated group. In the conservatively treated group, one complication (a deep vein thrombosis) was recorded, which was resolved by anticoagulation therapy lasting for six months.

DISCUSSION

The topic of PFMF remains controversial both in terms of terminology and treatment. Landorf et al. recommend distinguishing Jones' fracture from fatigue fracture of proximal diaphysis due to a different aetiology; on the other hand, from the perspective of fracture healing and treatment (6), they are in our opinion similar enough to justify their joint evaluation.

There is no agreement on the conservative vs surgical treatment in the literature, either. Quill et al. states that up to 50% of the proximal diaphysis and V. metatarsal metaphysis fractures (regardless of whether Jones or fatigue fractures) treated conservatively in non-weight-bearing fixation fail to heal, necessitating conversion to surgical treatment (14). These results and findings are in relatively good agreement with ours – in our conservatively treated patient group, 33% had to undergo conversion to surgical treatment. Still, Quill et al. recommend conservative treatment for physically less active patients and conversion to surgical treatment only if there are no signs of healing after eight weeks. In athletes, however, they always prefer acute osteosynthesis with an intramedullary screw (14). Similarly, Nunley et al. recommend surgical treatment only to athletes; for other patients, they suggest that the patient should choose the method of treatment (11). Baumfeld et al. who investigated the effectiveness of surgical therapy using lag screws in professional football players using, similarly to our study, AOFAS score for evaluation of treatment success, also recommends a surgical solution for these athletes (1).

Another study corroborating results by Quill and our results is a randomized prospective trial comparing conservative and surgical (screw fixation) treatment that also reported similar results – treatment failed in 8 out of 18 (44%) of conservatively treated patients (five non-unions, one delayed union, and two refractures) while treatment failure was recorded only in 1 out of 19 patients in the surgically treated group (10). Kavanaugh et al. also reported a large number of refractures after conservative treatment (3). In our study, we have not observed any refractures; however, this is not surprising as our patients were followed up only for twelve weeks.

Reviews by Roche (15) and Rosenberg (16) reported 72%–93% success rate of conservative non-weight-bearing immobilisation in Jones fractures; intramedullary screw fixation, however, yielded even better results (88–100%). By combining results from previous studies, Roche reported that only 44% of patients in whom delayed healing was observed healed satisfactorily. This was in line with our algorithm when we offered conver-

sion to surgical treatment to all conservatively treated patients who did not show good progress.

For surgical treatment of PFMF, the standard intramedullary screw is most commonly implanted (with or without grafting). Malkus et al. recommended the use of a tension loop with spongioplasty where conservative treatment fails (9). However, in our experience, the headless screw is an excellent option for osteosynthesis as compared to the standard cancellous screw, the entire screw is placed within the bone, thus minimizing the risk of irritation of the soft tissues by osteosynthetic material (and, in effect, minimizing the risk of the need for extraction). Although it provides less compression than a tension loop, and some authors highlight the importance of strong compression, Pietropaoli et al. demonstrated in his biomechanical study that bone fragments stabilization from shear forces is more important than compression (12). This is in line with our long-term experience with Herbert screws showing excellent healing success, even though we do not use any additional grafting. The results of the presented study, where the score was 95 or more in 13 out of 15 patients after six weeks and all 15 patients reached 100% AOFAS score within twelve weeks, support this conclusion.

We cannot properly compare the results after twelve weeks as three out of five patients from the conservatively treated group with the poorest result after six weeks were removed from this group and treated surgically. However, the comparison at six weeks clearly shows the superiority of the surgical treatment, which provided better AOFAS scores and a higher number of healed fractures according to X-ray at that time point. Even more importantly, the patients were able to return to their everyday activities very quickly (typically, as self-reported by the patients, within two to four weeks).

This is easy to explain when looking at the situation from the biomechanical perspective. The Jones fracture is located in the lateral central part of the foot arch. This fact alone causes it high loading during walking and standard physical activities. Supplementing the fragmented bone with internal fixation using an intramedullary screw prevents the shearing forces from dislocating the fragments and, thus, greatly facilitates healing (18). Although conservative treatment is possible, it is difficult to 100% prevent any loading of the foot and even an accidental stepping on the injured foot can cause the fragments to move, thus impairing the healing. This, as well as our results and results of aforementioned studies, indicates that surgical treatment with (preferably headless) screws is superior to conservative treatment and should be, in our opinion, offered to all patients with PFMF. This approach is all the more justified in athletes who need to return to their sporting activities as soon as possible.

The principal limitation of our study lies in the low number of treated patients. However, we acquired statistically significant results, which is a clear proof that the power of our study was sufficient to detect the difference and, in this case, demonstrate the superiority of the surgical approach using the Herbert screw over the conservative one. Also, flipping the coin was deemed a sufficient randomization method at the time of the study but resulted in unbalanced group sizes; another randomization method might have been more suitable.

Even though our results are very good, there are further directions of research that could lead to a better evaluation of the pros and cons of conservative and surgical approaches. For example, we have observed that patients after surgery were able to start walking very soon after the surgery. Recently, a novel method facilitating this evaluation has been developed – electronically monitored foot insoles (13) and pedography platforms (7) that would allow objective evaluation of loading of the injured limb at different time points after the surgery. Similarly, novel methods facilitating surgery are on the rise, such as computer-assisted surgery allowing individualized production of implants or screws (8). All these directions are worth to be investigated.

CONCLUSIONS

In this prospective study, we compared the outcomes of conservative treatment of the Jones fracture to those of the treatment with a two-threaded headless screw (Herbert screw). Our results imply that the surgical solution is superior to the conservative one, offering better healing rate after six weeks and 100% subjective treatment success after twelve weeks, the possibility of almost immediate loading of the injured limb and no complications. No reoperation was needed in our patient group, the only complication that occurred was a deep vein thrombosis in one patient from the conservatively treated group. Based on these results, we can recommend osteosynthesis of the fifth metatarsal screw by intramedullary Herbert screw as a method of choice in the treatment of Jones fractures.

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