

Calcaneal Displacement Osteotomies – Less Soft Tissue Irritation in Lateral Compression Plate than Screws

Posuvná osteotomie kalkanea – menší iritace měkkých tkání u laterální kompresní dlahy než při použití šroubů

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ABSTRACT

PURPOSE OF THE STUDY

With the concept of the lateral compression plate (LLCP) a technique has been available designed to combine the advantages of a fixed-angle fixation with a complete sinking of the implant into the proximal bone. The objective of the present study was to investigate the results of the LLCP compared with classical screw osteosynthesis (SO).

MATERIAL AND METHODS

31 patients with pes planovalgus who received calcaneal displacement osteotomy and osteosyntheses with screws (n = 17) or LLCP (n = 14) between 2010 and 2015 were investigated retrospectively. The ankle-hindfoot scale, Kaikkonen score, VAS, and the SF-36 were determined preoperatively as well as at the last clinical follow-up. In addition, a radiological control of osseous integration was performed in all patients 12 weeks after surgery.

RESULTS

With regard to clinical scores both methods depicted significant improvement. In the overall cohort there were no pseudarthroses. In the SO group 5 cases (29%) showed hardware irritation, in the LLCP group there were none. Results in the LLCP group were significantly superior in the area of the physical section of the SF 36.

CONCLUSIONS

Based on the results of our study, surgical treatment of stage II pes planovalgus by means of calcaneal displacement osteotomy using the LLCP is equivalent to SO with a lower incidence of hardware irritation.

Key words: pes planovalgus, lateral compression plate, osteosynthesis, screw, hardware irritation.

Level of Evidence: Level IV, retrospective case serie

INTRODUCTION

Pes planovalgus is commonly seen in adult patients – prevalence of approx. 10% (8). Major clinical signs are flattening of the longitudinal arch, midfoot abduction (too many toes sign) and heel valgus.

Patients in stage I of tibialis posterior insufficiency according to Johnson and Strom (2) show a regular hindfoot position (5) and generally benefit from conservative therapy (7). In contrast to this, patients in stage II present a flexible hindfoot valgus malalignment with midfoot abduction and often have to undergo surgery after unsuccessful conservative therapy. However there is no consensus about the optimal surgical procedure in stage II. Numerous different osseous and soft-tissue interventions have been described. A combination of medial soft-tissue intervention and medializing calcaneal displacement osteotomy is widely used (6, 13). Osteotomy with medial displacement of the calcaneal tuberosity not only corrects the hindfoot axis but also displaces the traction of the gastrocnemius-soleus complex medially

to the subtalar joint axis. It takes over an increasingly inverting force action and protects the medial soft-tissue reconstruction and corrects the hindfoot position (4). This procedure achieves excellent results with a minimal complication rate and a high degree of patients' satisfaction (3).

As a result of critical soft-tissue coverage hardware irritation is common. That is why fixed-angle plates have failed to become established for internal fixation thus far. Instead screw osteosyntheses (SO) remain the gold standard, despite a lack of angular stability. With the concept of lateral compression plates (LLCP) a technique has been available that is designed to combine advantages of a fixed-angle fixation with a complete sinking of the implant into the proximal bone.

The objective of the present study was to investigate the clinical and radiological results of the varus-producing calcaneal displacement osteotomy using the LLCP compared with SO.

MATERIAL AND METHODS

All patients with medial calcaneal displacement osteotomy due to pes planovalgus, corresponding to a tibialis posterior insufficiency stage II (Johnson and Strom) between 2010 and 2015 were included in this retrospective study. In all patients, a reconstruction or tightening of the medioplantar capsule-ligament complex of the talonavicular joint was performed as well as a FDL transfer and – if necessary – an Achilles tendon elongation. A minimum follow-up of 4 months was observed.

Age, sex, height and weight have been analysed and postoperative complications were documented. Preoperatively and during the last clinical follow-up the ankle-hindfoot scale, Kaikkonen score, VAS and the SF-36 were determined.

A radiological control of consolidation of the osteotomy was performed 12 weeks after surgery. Osteotomies were classified as consolidated showing osteogenesis bridging the osteotomy with a minimum width of 5 mm in both planes (Fig. 1).

Statistics: Group have been compared using the Mann-Whitney U-test and chi-squared test at a significance level of $p = 0.05$.

RESULTS

Thirty-one patients were included in the study, of whom 17 had been treated using SO and 14 with the LLC. Two men and 15 women were in the SO group,

and three men and 11 women in the LLC group (n.s.). The mean follow-up period was 45 ± 12.3 months in the SO group and 11 ± 6.3 months in the LLC group. The BMI was on average 28.3 ± 5.2 for the SO group and 27 ± 4.5 for the LLC group (n.s.).

Immediate postoperative complications did not occur in any of the patients investigated. However, in the SO group, in contrast to the LLC group, two recurrences were observed (n.s.), which required revision.

In the SO group, 5 patients (29%) complained of hardware irritation, compared with none in the LLC group ($p = 0.027$).

The VAS improved in both groups (SO from 5.9 ± 2.9 to 3.2 ± 2.5 , and LLC from 5.6 ± 2.3 to 3.1 ± 2.8).

The ankle-hindfoot scale (Table 1) and the Kaikkonen score (Table 2) showed no differences between the study groups. Patients in the LLC group had a significant higher score in the physical section of the SF-36 (Table 3).

All patients showed osseous consolidation of the osteotomy after 12 weeks (Fig. 1).

DISCUSSION

Our study shows that LLC leads to fewer hardware irritation than classical SO, with an equivalent consolidation rate.

Combined soft-tissue and osseous interventions are usually necessary to correct pes planovalgus malalignment. All procedures carry the risk of serious complications. The surgeon should always choose the least invasive procedure that is sufficient to treat the pain



Fig. 1. Radiographs 12 weeks after calcaneal displacement osteotomy by means of LLC and SO.

Table 1. Ankle-hindfoot score after operative intervention

Ankle-hindfoot score	SO	LLCP	p-value
postoperative	72.1 ± 20.4	61.6 ± 29.9	p = 0.2597

Table 2. Kaikkonen score after operative intervention

Kaikkonen score	SO	LLCP	p-value
postoperative	56.5 ± 27.0	46.8 ± 26.6	p = 0.3254

Table 3. SF-36 after operative intervention

SF-36	SO	LLCP	p-value
postoperative physical	36.0 ± 3.9	39.9 ± 3.4	p = 0.0073
postoperative mental	58.6 ± 8.2	55.1 ± 12.2	p = 0.6265

symptoms and improve function. For this purpose a knowledge of the expected clinical and radiological results, and especially possible complication rates of the different surgical procedures is necessary (12).

Varus-producing calcaneal displacement osteotomy combined with a medial soft-tissue intervention is a suitable procedure for treating flexible pes planovalgus – stage II according to Johnson and Strom (2). Here, various different options are available for fixation. In 2015 Chadwick et al. published good results after the treatment of patients with a lateral angle plate. This and the traditional method for fixation of the calcaneal osteotomy by means of cannulated screw osteosynthesis are associated with a high rate of hardware irritation and the need to remove implants. In literature the rate of hardware irritation after SO is between 11 and 47% (1, 9, 11, 14). The positioning of the LLCP and its flat design appear to be responsible for lower incidences of hardware irritation. The intramedullary position of the implant prevents irritations of the sural nerve and lateral soft-tissues. Scar and implant irritations in the area of the sole of the foot cannot occur because of the implant positioning. In addition, the fixed-angle plate enables a rotational stable fixation of the calcaneus in the corrected position.

While the LLCP is more expensive than SO costs are leveled out when hardware removals are significantly more frequently required after SO are taken into account (10).

The present study has several limitations. The design is retrospective and there is a lack of long-term results. Investigations have shown that the full extent of the improvement in symptoms postoperatively occurs after 1 year at the earliest (9). However, regarding the main hypothesis of a reduction in soft-tissue irritations through the LLCP the follow-up period appears to be sufficient.

In conclusion there were very few differences between the two study groups with regard to the scores (SO vs. LLCP) and osteosyntheses are equivalent in terms of pain reduction, postoperative function and patient satisfaction. However based on the low rate of soft-tissue irritations accompanied by an equivalent rate of osseous consolidation we would recommend the use of the LLCP.

CONCLUSIONS

Based on the results of our study, surgical treatment of stage II pes planovalgus by means of calcaneal displacement osteotomy using the LLCP is equivalent to SO with a lower incidence of hardware irritation.

Conflict of interest

We did not receive any benefits directly or indirectly from commercial parties.

Informed consent

Written informed consent was obtained from all patients before enrolment.

Ethical standards

The study was approved by the local Ethics Committee of the Friedrich-Schiller-University Jena EA 4905-08/16. C.M. and T.Z. contributed equally to this work.

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