



## Research article

## Physicians' experiences with indications and prescriptions of foot orthoses—A cross-sectional study in northern Germany

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## ABSTRACT

**Background:** Foot orthoses (FOs) are prescribed by general practitioners (GPs) and orthopedic surgeons for various complaints. As there are very limited medical guidelines and checklists, the prescription of FOs is often inconsistent. Therefore, our study to evaluate the general prescription behavior and indication experiences with FOs from the perspective of GPs and orthopedists.

**Methods:** A survey was carried out using a questionnaire from October to December 2021. GPs and orthopedic surgeons in northern Germany were included. The focus of the survey was to examine which foot problems would lead GPs and orthopedic surgeons to prescribe FOs and to evaluate what factors these physicians included in their diagnostic analysis. Apart from descriptive analyses, a stepwise linear regression analysis was performed to explore potential associations of the primary outcome variable 'specific effect on the prescription of FOs', which was introduced to shed light upon the estimated added value of the prescription of FOs.

**Results:** Out of the 790 questionnaires distributed, 184 questionnaires were returned by GPs (n = 95) and orthopedic surgeons (n = 74) (response rate 23 %). FOs were most frequently prescribed for talipes valgus (96 %) and heel spur (54 %). Diagnostic analysis was mainly carried out clinically. Custom-made FOs (82 %) were prescribed more frequently than prefabricated FOs (6 %). Regular interaction within the prescription process was most commonly with orthopedic technicians (61 %). The estimation of the specific effect on FO prescription was assessed by a mean of 66 % of the participants, 82 % recommended self-exercises as an additional therapy.

**Conclusions:** FOs are a specific and well-established aid prescribed by many GPs and orthopedic surgeons for a variety of foot complaints. Despite being one of the most frequently prescribed orthopedic devices, the utilization of FOs is predominantly explorative due to a growing but nevertheless still deficient body of well-researched evidence. There is a clear need for a uniform approach to the indication and prescription of FOs among physicians.

**Abbreviations:** FO, foot orthoses; GP, general practitioner; SD, standard deviation; VIF, variance inflation factor.

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## 1. Background

In Germany, foot orthoses (FOs) are prescribed by general practitioners (GPs) and orthopedic surgeons for various complaints [1]. These include plantar fasciitis, heel spurs, gonarthrosis, back pain, functional ankle instability, rheumatic diseases and hallux valgus syndrome [2–7]. In addition, FOs are prescribed for neurological conditions such as hemiparesis, infantile cerebral palsy, multiple sclerosis and Parkinson's disease [8–10]. Flat feet are one of the most common deformities of the feet and are also treated with FOs in all age groups [11,12].

In Germany, people with a statutory health insurance are entitled to the provision of orthopedics, which include the prescription of FOs, if they have an indication for treatment [13,14]. The binding Guideline on Medical Aids from 2020, which was adopted by the Joint Federal Subsidy Scheme, ensures that patients with statutory insurance are provided with sufficient, appropriate and economical medical aids. This specifies the precise information that must be provided by doctors when prescribing FOs. This includes the date, diagnosis, number, type of manufacture and production and the exact designation of the aid. In addition, healthcare providers are obliged to advise patients on the appropriateness and necessity of the FOs prescription [15]. In 2021, five million people in Germany received an FO prescription, incurring costs of 527 million Euros for the statutory health insurances [16].

There are few medical guidelines or checklists available worldwide for providing indications or prescriptions of FOs [17]. Accordingly, the prescription of FOs is often inconsistent and ranges from being based purely on clinical diagnoses to the use of digital motion analysis, force plates, radiological examinations or three-dimensional (3-D) imaging [18,19].

A distinction is made between providing cushioning and offloading of structures or to aim to systematically alter abnormal foot mechanics and function in order to alleviate symptoms. More generally speaking, it comes down to supporting, bedding, correcting or activating [20]. FOs are made from cork, leather, thermoplastics and fiber composites [21]. The individual indication with the symptom-oriented therapeutic target normally decides the function and the material of the corresponding FOs. There is no unanimity in the prescription of FOs with regard to type of FOs, material and form [22]. Additionally, there is currently a gap existing between practice and evidence in respect of the prescription and treatment of FOs [23]. To date, it is unclear as to what extent GPs and orthopedic surgeons are following uniform standards when determining indications for prescribing FOs [24]. Few studies have set out to explore what factors influence the prescription behavior of GPs and orthopedic surgeons. Most studies on this topic either deal with rather specific target groups of patients, with a specific sample of physicians or focus on a single way of producing FOs [25,26].

The aforementioned factors of unknown mechanisms of action and lack of evidence as well as the high costs associated with the prescription of FOs highlight the importance of further research in this area. Therefore, our study aimed to evaluate the general prescription behavior and indication experiences with FOs from the perspective of GPs and orthopedists.

## 2. Methods

### 2.1. Design and participants

The study conformed to the STROBE Guidelines (Strengthening the Reporting of Observational Studies in Epidemiology) (see supplementary file 1) [27]. Our research was conducted in Schleswig-Holstein, a federal state in northern Germany.

### 2.2. Recruitment of participants

For the survey, physicians were recruited via the directory of the Association of Statutory Health Insurance Physicians, Schleswig-Holstein [28]. The addresses of 500 GPs and all 290 orthopedic surgeons were available in the register of the Association of Statutory Health Insurance Physicians, Schleswig-Holstein. GPs and orthopedic surgeons received an invitation to the survey by means of a letter with a link to the online survey hosted on the SurveyMonkey at the beginning of October 2021 [29]. Two reminders were sent out at four-week intervals, one with the link and one with a paper-based questionnaire. The survey was conducted in the period between October and December 2021.

### 2.3. Measurement

The survey was developed on the basis of qualitative interviews, the experiences of two physiotherapists (MH, KG) and one GP (JS) as well as a systematic review [24,30]. The interview questions included the decision criteria for prescribing FOs, custom vs. conventional FOs, reviews of FOs manufacturing, exchanges with other professionals and complementary treatment measures in cases where FOs were prescribed. Interviews were conducted with four GPs and two orthopedic surgeons. Afterwards, the questionnaire was presented to independent examiners for piloting. The questionnaire was not formally validated. In total, the final questionnaire contained 13 questions (see supplementary file 2). Apart from socio-demographic data, the questions queried which diseases are treated with orthopedic FOs, the number of FOs prescribed per month, the age group of those who had FOs prescribed, the type of FOs prescribed, aspects of the examination, a review of FO production, further treatment recommendations, supporting criteria decision making, exchange with other professional groups and optimization of the prescription of FOs. Different response options were used throughout the questionnaire, such as multiple choice, multiple response options possible and free text input.

Regarding the real added value of FOs, we specifically aimed to draw the attention of our sample to this very topic. Consequently, this matter was evaluated using the following question: "What percentage of the effect size of a FOs prescription is due to the specific effects of the FOs?" Accordingly, in the remainder of the text, we refer to the estimated added value of prescribing FOs as "estimated

specific effect of the FOs”.

## 2.4. Data analysis

The statistical analysis was carried out using the SPSS 27.0 (SPSS Inc., IBM) software package [31]. First, the results were recorded descriptively using the mean values, standard deviations (SD) and percentages. Subgroup analyses were calculated by using chi<sup>2</sup>-test for gender differences, area of practice (urban vs. rural) and work experience. The cut-off in respect to the median (20) work experience was grouped into ‘20 years and less’ and ‘more than 20 years’ to enable a comparison between less experienced and highly experienced physicians. Afterwards, a stepwise linear regression analysis was performed to explore the estimated added value of FO prescriptions. Potential associations between the dependent variable ‘specific effect on the prescription of FOs’ and independent variables which correlated significantly with the dependent variable were examined. Additionally, the possibility for multicollinearity was considered. The variance inflation factor (VIF) and the value of tolerance of the regression model were reported. Values for the VIF are not supposed to be above 5.0 and are also not supposed to be lower than 0.25 for tolerance [31]. An alpha level of  $p < 0.05$  was used for the test of statistical significance.

## 3. Results

Of the 790 questionnaires sent, 184 questionnaires were returned, a response rate of 23 %. The questionnaire was filled out by 95 GPs and 74 orthopedic surgeons. 15 participants did not provide any information about their profession. The characteristics of the study sample are shown in Table 1.

The estimated specific effect on FO prescription was assessed by a mean of 66 % (SD  $\pm$  20.8; range between 0 % and 100 %).

### 3.1. Indications, prescription quantity and age of prescribed FOs

The indications for prescribing FOs were most often talipes valgus (96 %), heel spur (54 %), plantar fasciitis (39 %), flatfoot (31 %), hallux valgus (27 %), achillodynia (16 %), rigidus (15 %) and knee pain (13 %). On average, 26 (SD  $\pm$  39) pairs of FOs were newly prescribed per month per physician. As follow-up prescriptions, 48 (SD  $\pm$  28) pairs of FOs were prescribed per month. Most of the prescribed FOs were custom-made (82 %), followed by prefabricated FOs (6 %), and activating FOs (2 %).

FOs were most frequently prescribed to adults up to 65 years of age (69 %), followed by seniors of 65 years and older (10 %). Adolescents and young adults made up the smallest proportion (2 %).

### 3.2. Examination methods of flatfoot and reassessment methods for FOs

Table 2 shows the methods of examination for foot problems. Almost all the physicians performed an inspection (96 %), followed by taking the history of the patient (88 %), and palpation and gait analysis (81 %). The majority of physicians (69 %) took a detailed look at the everyday shoes and some physicians (19 %) ordered an X-ray to arrive at a diagnosis. A bit more than half of the sample made a control appointment with the patient to check the fitting of the FOs (mean = 3.52; scale from 1 ‘never’ to 6 ‘always’). Around a fifth of the participants (22 %) performed no method of reassessment.

### 3.3. Decision support for the kind of FOs

Apart from their indications, the participants were also asked which criteria they used to support their decision about which type of FOs to prescribe. Criteria guiding their decisions were mainly the past treatment with FOs (62 %) and the discomfort of patients (61 %). Table 3 gives an overview of guiding criteria.

**Table 1**  
Description of the study sample (n = 184).

Characteristics <sup>a</sup>	Mean (SD)
Age per year; range	55.0 (8.6); 26 - 76
Work experience per year; range	20.2 (9.5); 1 - 44
	<b>Number (%)</b>
Gender	
Male	117 (64.0)
Female	52 (28.3)
Area of practice	
Urban area	102 (55.4)
Rural area	63 (34.2)
Profession	
General practitioner	95 (52.0)
Orthopedic surgeon	74 (40.2)

<sup>a</sup> Numbers varies due to missing data; SD standard deviation.

**Table 2**  
Description of examination methods for flatfoot and reassessment methods for FOs (multiple answers).

Examination methods	Number (%)
Inspection of the foot	166 (96.0)
Anamnesis	153 (88.4)
Palpation of the foot	140 (81.0)
Gait analysis	140 (81.0)
Examination of usual footwear	120 (69.4)
Mobility test of the foot	97 (56.1)
X-ray	32 (19.0)
Footstep impression	31 (18.0)
<b>Reassessment methods</b>	
Evaluation of patient satisfaction	113 (68.0)
Control of the design	96 (58.0)
Fitting of FOs on the loaded foot	68 (41.0)
Palpation of the foot	58 (35.0)
Fitting of FOs on the unloaded foot	44 (26.3)
Gait analysis	36 (22.0)

**Table 3**  
Description of the criteria for supporting a decision (multiple answer option).

Criteria	Number (%)
Past treatment with FOs	106 (62.4)
Patient discomfort	103 (61.0)
Experience	99 (58.2)
Pain reported by patient	85 (50.0)
Physical activity	68 (40.0)
Age of patient	67 (39.4)
Gait analysis	62 (37.0)
Comorbidity of patient	48 (28.2)
Patient expectations	30 (18.0)

### 3.4. Cooperation with other professional groups and treatment recommendations

Participants stated that regular exchanges with orthopedic technicians (n = 105; 61 %) followed by orthopedic surgeons (n = 64; 37 %), physiotherapists (n = 37; 21 %), GPs (n = 22; 13 %) and surgeons (n = 11; 6 %) took place during the prescription of FOs. However, some participants (n = 31, 18 %) had no cooperation with other professional groups. An overview of treatment recommendations of FO prescriptions is given in [Table 4](#). Self-exercises were recommended most often (82 %). Few (6 %) did not recommend any treatment in addition to the FOs prescribed.

### 3.5. Treatment path of FOs

The respondents desired more evidence in support of a defined treatment path for the prescription of FOs (43 %), for the development of a standardized guideline (42 %) and for more studies concerning FOs (31 %). Nearly a third of the physicians (30 %) were in favor of the health insurance funds covering the full costs of FOs and a bit less than a fifth (18 %) were in favor of a uniform catalogue of reimbursements and indications for the health insurance funds. A standardization of the production of FOs by orthopedic technicians was favored by a fifth of our sample (21 %). In addition, 22 % of our participants preferred industry-free interdisciplinary training for FOs care.

**Table 4**  
Description of treatment recommendations for FOs prescription (multiple answers).

Treatment recommendation	Number (%)
Self-exercises	142 (82.1)
Walking barefoot	109 (63.0)
Physiotherapy	58 (34.0)
Analgesic treatment	38 (22.0)
Nordic walking	21 (10.0)

### 3.6. Sub-group analyses

Subgroup analyses were performed for the variables ‘gender’, ‘area of practice’ and ‘work experience’ concerning different aspects of the prescription of FOs. There was no difference between GPs and orthopedic surgeons in the prescription of FOs. It was observed that male physicians (mean = 28.69) prescribed more FOs per month than female physicians (mean = 20.1;  $p = 0.031$ ). The category ‘area of practice’ with regards to ‘urban vs rural’ showed that the diagnosis of plantar fasciitis was made significantly more often in urban areas (45.1 %) than in rural areas (23.8 %), with a  $p$ -value of 0.006. The diagnosis of a heel spur was made significantly more often in rural (65.1 %) than in urban areas (47.1 %), with a  $p$ -value of 0.024.

Moreover, a significant difference was found in the variable ‘age of patients’. Patients up to 65 years of age were prescribed FOs significantly more often in urban areas (79.3 %) than in rural areas (73.8 %); with  $p = 0.022$ .

For the variable ‘work experience’, it was found that physicians who had 20 years or less work experience (37.9 %) diagnosed flatfoot more often than physicians who had 20 years or more experience (23.6 %), with  $p = 0.05$ .

### 3.7. Associations with the estimation of the specific effect of FOs prescription

Table 5 reports the last step of the linear regression analysis with the outcome variable ‘estimation of the specific effect of FOs prescription’. A model with two steps was run, which explained 10.9 % ( $R^2 \sim 0.109$ ) of the variance on the dependent outcome variable ‘estimated specific effect on FO prescription’. All regression coefficients of the items in the stepwise regression analysis were statistically significant. These were ‘comorbidity of patients’ and ‘more studies concerning FOs’.

## 4. Discussion

Our results show a first overview regarding the indication and prescription behavior pattern for FOs of GPs and orthopedic surgeons. Our sample of participating physicians shows a high degree of professional experience, with a majority (80 %) working with inspection, anamnesis, palpation and gait analysis. Their average age is 55 years and physicians are predominantly male. In terms of age and gender, our sample of physicians is generally comparable with physicians in Germany [32].

In line with our results, talipes valgus is known to be one of the most common pathologies in the consultation hours [33]. Our results show that FOs were frequently prescribed in urban and rural areas for plantar fasciitis, heel spurs and flat feet.

Moreover, GPs and orthopedic surgeons state that an interdisciplinary exchange with other professional groups, especially with orthopedic technicians and physiotherapists, would be highly beneficial to their prescription behavior and quality of care. Interdisciplinary patient-focused work would be a significant improvement regarding the individual treatment of patients. This might lead to a reduction in morbidity rates as well as to a reduction in additional examinations, which in turn might lead to a reduction of costs within the health care system. It may also furthermore lead to an increase in job satisfaction for all parties involved [34]. Therefore, it is of enormous importance that in interprofessional cooperation, one person bears responsibility [35]. In most cases, the GP functions as that person, as they are the patient’s first medical contact [36]. In our results, there was no difference in the prescription behavior of FOs between GPs and orthopedic surgeons. This might be due to FOs being recognized as effective medical devices across disciplines [21].

Concerning the subgroup analysis between rural and urban areas and different aspects of the prescription for FOs, our results show that plantar fasciitis was diagnosed more frequently in urban areas and heel spurs were diagnosed more frequently in rural areas. However, to our knowledge there are only few comparable studies on this topic addressing by different caregivers [37]. Future studies should address possible reasons for this finding, other than selection bias.

Furthermore, patients up to 65 years of age who live in the city were prescribed FOs more often than those living in the countryside. It can be assumed that due to demographic change and more older people living in the city, FOs are prescribed more often in urban areas [38,39]. Our results show that there is no common approach to diagnosis, as has been described previously in other studies [40].

Moreover, our results observe that a defined treatment path as well as studies on the real added value of FOs are a prerequisite for a homogenous way for indication and prescription behavior. This can help prevent the continuously rising costs for health insurance companies in Germany [41,42]. As a result, it would be desirable to have clinical guidelines for treatment with FOs in the future. Existing guidelines such as “Child’s flat foot” or the Delphi consensus study from Australia might offer an orientation for the indication and prescription of FOs, to establish standardized guidelines in Germany as soon as possible [17,43].

As for the estimated specific effects of FOs, two distinct variables seem to play a role: a patient’s comorbidity as well as the desire for further studies on the evidence of FOs. While a present comorbidity has been found to be associated with a higher estimation of the

**Table 5**

Associations of individual characteristics, different aspects concerning FOs prescription on the estimated specific effect on the prescription of FOs (Results of stepwise linear regression analysis, under specification of standardized beta coefficient,  $\alpha = 5\%$ ).

	Step 1	Step 2	VIF-value	Tolerance value
Comorbidity of patients	0.247	0.268	1.00	1.00
More studies concerning FOs		-0.249	0.99	1.01
$R^2$	0.054	0.109		

Only coefficients with statistical significances at the  $p < 0.05$  level were reported.

specific effects of the FOs, the wish for further studies on the evidence of FOs has been found to be associated with a lower estimation. It can be assumed that physicians prescribing FOs for a variety of foot and lower limb problems results in a higher estimation of the addressed added value of FOs. Furthermore, it could be that physicians are to a degree skeptical about the added value of FOs. Consequentially, these physicians wish for more studies on this topic.

#### 4.1. Limitations

This is the first observational study with GPs and orthopedic surgeons on the indication and prescription of FOs in Germany. The response rate was 23 % and is comparable to a study from Australia [21]. However, a longer recruitment period could lead to a higher response rate as an example of a study in England showed [44].

In addition, allowing multiple types of responses in the questionnaire caused certain difficulties. The questionnaire was sent to orthopedic surgeons and GPs as a pilot, but was not formally validated. Moreover, the survey was sent only to GPs and orthopedic surgeons regarding their experiences with FOs and should be expanded in further studies to include physiotherapists and/or physiatrists. This is an early-stage study and the available information was very limited. Therefore, no power calculation was performed. Finally, this was a cross-sectional study and one must therefore be cautious about deriving causal links from these findings.

#### 4.2. Conclusions

FOs are a specific and well-established aid prescribed by many GPs and orthopedic surgeons for various foot problems in Germany. However, there is a need for a more uniform procedure for the indication and prescription of FOs among physicians. Moreover, the development and implementation of a guideline could improve the process of prescription behavior and provide evidence-based information.

#### Ethics approval and consent to participate

The study was approved by the Ethics Committee of the University of Luebeck, Germany (Approval number 21–062) in June 2021 and was conducted in accordance with the Declaration of Helsinki. Informed consent was obtained from all subjects.

#### Consent for publication

Not applicable.

#### Data availability statement

The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

#### Funding

The study received no funding.

#### CRedit authorship contribution statement

**Minettchen Herchenröder:** Writing – original draft. **Katja Goetz:** Writing – original draft, Supervision, Formal analysis. **Tjorven Stamer:** Writing – original draft, Formal analysis. **Malte Klee:** Writing – review & editing. **Jost Steinhäuser:** Writing – review & editing, Resources, Project administration, Methodology, Conceptualization.

#### Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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#### Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.heliyon.2024.e33584>.

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