Long-Term Outcome After Operative Management of Talus Fractures

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Abstract

Background: Controversies remain regarding the preferred treatment strategy for talus fractures. The primary goal of this study was to evaluate the long-term outcome after operative management of talus fractures. Secondly, we identified those factors that affected the outcome and defined strategies to improve the outcome.

Methods: This is a retrospective outcome study of 84 patients with an average follow-up time of 9.1 years. We assessed the functional results, return to daily activities, and general health status using the Foot Function Index-5pt, a numeric rating scale for pain, and the Short Form-36 Health Survey. Furthermore, we conducted a correlation analysis between the outcomes and 14 demographic, clinical, and radiologic variables.

Results: We found moderate mean Foot Function Index pain and disability scores of 30.2 and 28.7, respectively. The mean numeric rating scale score was 3.2. Of all responders, 41% (27/66) did not return to their daily activities. We reported low physical, but good mental, Short Form-36 component summary scores of 42.7 and 48.3, respectively. We recorded a complication rate of 56%. Osteoarthritis, articular incongruence and talus body fractures correlated significantly with a poorer functional outcome. Delayed surgery after trauma was associated with better outcome measures.

Conclusions: Talus fractures have a major long-term impact on ankle and hindfoot function and on physical health. Success of operative treatment depends on the occurrence of osteoarthritis postoperatively, type of fracture, and quality of fracture reduction. Because only the latter is modifiable, efforts should be made to restore articular congruence in order to improve the outcome. Therefore, we recommend reviewing the quality of the reduction postoperatively on CT. Furthermore, talus fractures should not be considered operative emergencies, but rather treated after recovery of the soft-tissues.

Level of Evidence: Level III, comparative study.

Keywords: operative treatment, talus fractures, determinants of outcome

Talus fractures are rare and account for 0.3% of all fractures and only 3.4% of foot fractures.¹⁹ With no less than 7 articular surfaces, the talus provides the junction between the lower leg and the foot.^{2,25} Articular reduction and fixation of talus fractures is often technically challenging, though in the end crucial for ankle and hindfoot function. Nevertheless, there are only a limited number of studies on long-term outcome after operative management of talus fractures.^{12,14,21,23} Moreover, operative techniques have considerably been refined during the last 20 years, and hence the proper operative strategy remains a topic of discussion.^{28,30,32} Our primary endpoint was assessing the long-term functional outcome and general health status after operative management of acute talus fractures. Secondly, we identified the clinical and radiographic parameters that influenced the outcome in order to improve treatment strategies and outcome of talus fractures.

Methods

Patients and Setting

Eighty-four consecutive adult (≥ 18 years) patients with 85 talus fractures were included and 66 patients did respond in this retrospective single-center cohort study. All included patients were treated operatively for an acute talus fracture within 30 days after trauma at the Department of Trauma Surgery or the Department of Orthopaedic Surgery of the University Hospitals Leuven, Belgium, between January 2000 and July 2016. Notably, patients with isolated osteochondral lesions were excluded. The identification/inclusion process is depicted in Figure 1. This study was performed according to the Belgian legislation after approval by the ethics committee of University Hospitals Leuven.

Demographic, Clinical, and Radiologic Characteristics

We defined 17 study variables, of which 8 were demographic (age at the time of trauma, gender, American Society of Anesthesiologists [ASA] score, body mass index [BMI], smoking, daily alcohol use, diabetes mellitus, and other cardiovascular risk factors [CVRFs]) and 9 were clinical characteristics (fracture type, associated fractures of the same foot or ankle, open fractures, time of treatment, type of definite surgery, operative approach, malleolar osteotomy, postoperative complications, and reinterventions).

CVRFs were categorized as follows: age of 55 years and over, overweight (BMI more than 25), smoking, daily alcohol use, diabetes mellitus, and other CVRFs (hypercholesterolemia, dyslipidemia, hypertension, or current cardiovascular diseases). Fracture type was defined as either body, neck, and/or head fracture. Neck and head fractures were classified by the Hawkins classification, modified by Canale and Kelly (Supplemental Addendum I).⁵ Body fractures were classified according to Sneppen et al (Supplemental Addendum II).³¹ Open fractures were classified according to Gustilo-Anderson classification system.²⁰

Time of treatment was displayed as early (time from trauma to surgery less than 24 hours), delayed (more than 24 hours) or delayed-staged (closed reduction with external fixation [CREF] before definitive surgery). Time to definitive surgery was registered in all patients treated according to a delayed (-staged) surgery protocol. Definitive surgery was classified as (plate and) screw osteosynthesis [(P)SOS], K-wiring, CREF, primary arthrodesis, or total talus transplant with allograft. Operative approaches were categorized as anterior, anteromedial, anterolateral, posteromedial, or posterolateral.⁹ In addition, we registered whether a single or dual approach (triple approach $n = 1$) was performed. Postoperative complications were operative site infection, articular incongruence, nonunion, avascular necrosis (AVN), osteoarthritis and other postoperative complications (intra-articular material, talar impingement, or equinus deformity). Articular incongruence was defined on postoperative radiographs or CT when available, as an intra-articular gap or step of more than 2 mm, or more than 5 degrees angulation in any plane.¹³ Nonunion was defined at 9 months postoperatively as a not completely healed fracture without progression toward healing over the 3 preceding months.³ AVN and posttraumatic peritalar osteoarthritis were evaluated on follow-up radiographs. Osteoarthritis was subdivided by location in ankle (tibiotalar and/or fibulotalar), other peritalar, or both ankle and other peritalar osteoarthritis. Reinterventions were noted as reintervention rate and total number of reinterventions. Reintervention rate is the number of patients with 1 or more reinterventions, categorized as material removal, secondary arthrodesis, ankle prosthesis, and other reinterventions (reoperation, arthrolysis, [partial-] talectomy, adjustable hybrid external fixator, nonunion repair, and arthroscopic debridement).

Outcome Measures

All included patients were sent a questionnaire to evaluate the functional outcome and general health status (Supplemental Addendum IV). The date of completing the questionnaire was defined as the end of follow-up. The Foot Function Index (FFI)-5pt Dutch version was used to assess the functional outcome in terms of pain and disability. The FFI-5pt ranges from 0 to 100. A higher score implies worse functionality. Additionally, a numeric rating scale (NRS) was used to measure pain on a scale from 0 (no pain) to 10 (worst imaginable pain). Quality of life was assessed using the Short Form-36 Health Survey (SF-36) Dutch version.

SF-36 also ranges from 0 to 100, but a higher score indicates a better general health. Both the FFI and the SF-36 are standardized questionnaires, with verified reproducibility, validated for the Dutch language.^{1,22} Furthermore, we assessed if patients returned to their daily activities.

SF-36 subscale scores were calculated using standard scoring algorithms according to Ware et al.³⁷ and the physical (PCS) and mental (MCS) component summaries were calculated using country-specific mean and standard deviations, United States factor score coefficients, as advised by Taft et al.³³ As such values do not exist for Belgium, we chose the mean PCS and MCS scores of the Netherlands, derived from the “National Study” as reference for norm-based scoring.¹ A score of 50 on the PCS or MCS corresponds to the mean value of the Dutch population. Patients were categorized as unable to return to their daily activities if they indicated to have another job as a consequence of their foot/ankle injury, the same job with adjustments, to be no longer capable to work because of their foot/ankle, or to be retired and hindered by their foot/ankle in their daily activities.

Statistical Analysis

All data were statistically analyzed using IBM SPSS Statistics 24.0 (SPSS Inc, Chicago, IL). The Mann-Whitney *U* test was used for comparing nonparametric variables. Nominal variables were compared using χ^2 or Fisher exact statistics. A statistically significant χ^2 test in case of a multinomial or categorical variable was followed by post hoc multiple pairwise comparisons. Correlations with nominal outcome variables were tested with logistic regression. Correlations with continuous outcome variables were tested with Spearman correlation for nominal and Pearson correlation for continuous predicting parameters. For each outcome parameter, we conducted a stepwise multiple regression analysis with all significantly correlated predicting variables. A significance level of $P < .05$ was accepted for all tests.

Results

Demographic, Clinical, and Radiologic Characteristics

All patient characteristics are shown in Table 1 (see also Supplemental Table S1). A total of 66/84 (78.6%) patients with 67 talus fractures responded to our questionnaire (Supplement Table S8). The median clinical follow-up time was 106 (IQR 62-154) months, whereas the median radiologic follow-up time was 22 (IQR 9-45) months. Responders and nonresponders differed significantly in ASA score at the time of trauma ($P = .039$). Post hoc multiple pairwise comparison showed a significant difference in number of patients with an ASA 3 score, which was 0/63 and 2/17 for responders and nonresponders, respectively. The quality of reduction was assessed postoperatively on both radiographs and CT scan. A postoperative CT was performed in 77.6% of fractures: 16.4% had a CT scan in the first 30 days postoperatively and 58.2% in the first year postoperatively, though most patients within 3 months.

Functional Outcome and General Health Status

Mean outcome scores of all responding patients are displayed in Table 2 (see also Supplement Table S2). On the total FFI, 7/66 patients (10.6%) scored 0, meaning they experienced neither pain nor disability due to their foot in the last week of follow-up. Eight of 66 patients (12.1%) indicated to have no pain on the FFI pain scale. Eleven of 66 patients (16.7%) indicated to have no disabilities on the FFI disability scale (Supplement Table S4). On the NRS pain score, 14/63 patients (22.2%) scored 0, whereas 18/63 patients (28.6%) scored 5 or more on 10. SF-36 outcomes indicate a major impact of talus fractures on physical health status, whereas the mental health status was comparable to the reference population (reference value 50) (Supplement Table S5).

Outcome Measures Intercorrelation

FFI pain, FFI disability, NRS pain, and SF-36 PCS scores were all highly intercorrelated (R^2 values ranging from 0.501 to 0.723, all $P < .001$). Return to daily activity was also correlated with these outcome measures (R^2 values ranging from 0.146 to 0.360, all $P < .01$). SF-36 MCS scores were significantly correlated with FFI pain ($R^2 = 0.142$, $P < .01$), FFI difficulty ($R^2 = 0.089$, $P < .05$), and NRS pain scores ($R^2 = 0.117$, $P < .01$) (Supplement Table S6).

Factors Affecting Outcome

Correlations between patient characteristics and the FFI, NRS pain, and SF-36 are displayed in Table 3. One of the surgeons at our institution operated on 55% of all talus fractures. His patient-reported outcome was better on every scale compared to other surgeons', which was statistically significant for FFI pain ($R^2 = 0.077$, $P = .025$) (Supplement Table S9). In 3 fractures, definite treatment was performed by a fellow. All other fractures were treated by staff surgeons.

After stepwise multiple regression analysis, the presence of osteoarthritis turned out to be the most predictive factor of poor outcome for all our outcome measures, except for NRS pain, where the presence of a complication was the most predictive factor, for return to daily activity, where a head fracture seemed of major impact, and except for SF-36 MCS, where the presence of a body fracture was the most predictive factor. In the absence of complications, SF-36 scores are comparable to the general population, as shown in Figure 2. Other factors that were derived from the stepwise multiple regression analysis were as follows: body fractures for the FFI pain (model $R^2 = 0.414$), delayed surgery and nonunion for the FFI disability (model $R^2 = 0.409$), body fractures for the NRS pain (model $R^2 = 0.408$), articular incongruence, delayed surgery and primary arthrodesis for the SF-36 PCS (model $R^2 = 0.512$), and open fractures, dual approach, and ankle osteoarthritis for return to daily activity (model Nagelkerke $R^2 = 0.506$). All P values of the above-mentioned models were lower than 0.001, and only delayed surgery was of positive influence on the outcome measures. For the SF-36 MCS, stepwise multiple regression analysis showed a model in which the presence of a body fracture was associated with worse SF-36 scores (model $R^2 = 0.123$, $P = .005$) (Supplement Table S7).

Most Important Determinants of Outcome

Postoperative complications, fracture type, and time to surgery were identified as important outcome predictors. Postoperative complications (ie, osteoarthritis) were the most important determinants affecting the outcome (Table 3).

Medial osteotomy was associated with higher ankle osteoarthritis rates ($R^2 = 0.154$, $P = .001$). Other peritalar osteoarthritis rates were higher for open fractures ($R^2 = 0.069$, $P = .031$) and increasing Gustilo-Anderson grade ($R^2 = 0.078$, $P = .022$). When flap reconstruction was required for wound closure (3/65 of the responding patients), none of the patients returned to daily activities and outcome scores were very poor (Figure 3). Some complications required operative treatment with secondary arthrodesis. In our study, secondary arthrodesis rates were 23.2% at the 5-year and 25.7% at the 10-year follow-up (Figure 4). The 5-year secondary arthrodesis rates were 44.4% for head, 20.4% for neck, and 24.7% for body fractures. Taking primary and secondary arthrodesis together in our correlation analysis, we found significant correlations with poor FFI, VAS, and SF-36 PCS scores, as well as failure to return to daily activity (R^2 values ranging from 0.071 to 0.175; all $P < .05$).

Articular incongruence as an early predictor of osteoarthritis was found to be associated with fracture severity. Articular incongruence rate was 0/10 for Hawkins 1 type of neck fractures, which differed significantly from Hawkins 2 (5/12), Hawkins 3 (1/3), and Hawkins 4 fractures (2/2) ($P = .013$). In talus body fractures, articular incongruence rate was (in order from high to low) 3/6 in Sneppen 5, 3/7 in Sneppen 2, 3/8 in Sneppen 3, 1/7 in Sneppen 4, and 2/17 in combined body fracture types. Furthermore, articular incongruence was associated with a posteromedial approach ($R^2 = 0.133$, $P = .003$) and significantly lower in an anterolateral approach ($R^2 = 0.071$, $P = .030$).

Regarding fracture type, the presence of a body fracture was associated with the poorest outcome scores. Sneppen 5 fractures had the worst outcome scores (Figure 5) (Supplement Table S3). All Sneppen 5 fractures in our study ($n = 6$) had postoperative complications.

Also, the time of treatment seemed an important factor in the outcome of talus fractures. More specifically, delayed surgery was the most important factor associated with better outcome scores (Table 3). Lower osteoarthritis rates (especially ankle osteoarthritis) were observed in patients treated delayed (31.7% vs 64.0% for delayed vs early surgery, respectively, $P = .010$). A delayed-staged surgery protocol was mainly used for the treatment of talus body fractures (particularly in Sneppen 5) and therefore correlated with less favorable outcome scores (Figure 6).

Discussion

The aim of this study was to evaluate the functional outcome and general health status after the operative treatment of talus fractures and define those variables that affect the outcome in order to define strategies to improve the outcome. Our patients reported mean FFI-5pt pain and disability scores of 30.2 and 28.7, respectively. Overall, 58/66 (87.9%) of the responding patients reported pain and 55/66 (83.3%) disability during daily activities at a mean follow-up of 109 months. Regarding NRS pain scores, 18/63 (28.6%) of the patients scored 5/10 or higher at rest. Also, 27/66 (40.9%) of the responding patients did not return to their daily activities. Vallier et al³⁴ reported for talus neck fractures comparable FFI scores of 25.3 and 34.4, respectively. For talus body fractures, Vallier et al³⁵ and Sen et al³⁰ found worse mean FFI pain and disability scores; however, they excluded lateral and posterior process fractures. Talus fractures have an important (negative) impact on physical health (PCS 42.7), whereas mental health (MCS 48.3)

was comparable to the reference values of the general Dutch population. As previously reported by others, outcome measures were highly dependent on the presence of postoperative complications.¹⁰ In the absence of postoperative complications, physical SF-36 scores were comparable to those of the general population as well. Patients who required flap reconstruction (Gustilo- Anderson grade 3b and 3c open fractures) showed very poor outcome scores; none of them returned to daily activities. Because of the small number, however, significance was low (except for return to daily activities). In our series, 25.7% of cases were treated with secondary arthrodesis by the end of follow-up. This is comparable with Fournier et al,¹³ who described a secondary arthrodesis rate of 25.4%. In concordance with their study, secondary arthrodesis was mostly performed in the first 5 years (23.2%).¹³ This leads to loss of function of the joint and is associated with poor functional outcomes.^{5,13} Arthrodesis rates were highest in talar head fractures, which were associated with a lower return to daily activities.

Unfortunately, talus fractures are associated with high complication rates.^{10,13,25,34} We found a postoperative complication rate of 56.5%, mainly osteoarthritis (42.4%), which in turn affected the outcome most. In concordance with other studies, we found higher rates of osteoarthritis with longer radiologic follow-up.²⁵ Although we had a longer mean clinical follow-up time compared with other studies (9.1 years), mean radiologic follow-up time was shorter (3.1 years). Hence, the actual osteoarthritis rate is probably higher and may explain our rather low rate as compared to other long-term studies (37%-100%, with follow-up times of 6-9.8 years).^{13,15,23,25} Lower osteoarthritis rates were observed in patients in whom definitive surgery was delayed.

The second most important postoperative complication was articular incongruence, which was strongly associated with poor FFI pain, NRS pain and SF-36 PCS scores. The observed postoperative articular incongruence rate was 18/79 (22.8%) and resembles previous measurements that vary from 25% to 33%.^{13,25} Postoperative articular incongruence is considered a predictor of osteoarthritis at longer follow-up; however, we could not prove this.²⁸ This may be explained by the difference in mean radiologic follow-up in patients with articular incongruence (osteoarthritis vs nonosteoarthritis, 52.5 vs 17.6 months, respectively). To reduce articular incongruence rates, a CT is indispensable to accurately classify and guide treatment decision making preoperatively.^{6,9,13,28} Given the important impact of articular incongruence on outcome, we suggest reviewing the quality of the reduction postoperatively on CT. Already in 1990, Adelaar suggested operative revision in case of more than 5 mm or 5 degrees postoperative fracture displacement.²

AVN and its influence on treatment outcome is widely studied.¹⁰ Especially, displaced talar neck fractures are known to be associated with disruption of most of the talar vascularization, eventually leading to AVN. In the metaanalysis of Dodd et al,¹⁰ studies performed from 2000 onward had an overall AVN rate for talar neck fractures of 24.9%. We observed an overall AVN rate of 12.9%, and this did not correlate with poor outcome. Fournier et al¹³ reported up to 59% asymptomatic AVN and only talus collapse was significantly correlated with poor outcome. We had only 3 responders with talus collapse and could not find any significant associations. To reduce AVN rates, some previous studies advocated early stable fixation, which would protect the remaining blood supply.^{11,14,15,17,19} In contrast, Crist et al⁸ stated that early surgery through traumatized soft tissues can even further harm the already damaged blood supply. More recent studies doubt on any relationship between timing of fixation and AVN rates and consider the initial degree of fracture displacement with disruption of the blood supply to be the most important risk factor.^{2,4,7,8,11,14,16,18,19,23,24,26,28,34,35} Furthermore, some authors pointed out that certain operative approaches affect the vascularization and increase the risk for AVN.^{13,20} We neither found an association between the timing of surgery nor the chosen operative approach and AVN.

Regarding the above-mentioned timing of surgery, we found delayed surgery to be associated with good outcome scores and low ankle osteoarthritis rates, whereas early and delayed-staged surgery were associated with poor outcome. Early surgery seems no longer a valid option. Vallier et al³⁴ advised to delay definitive fixation, to allow healing of the traumatized soft-tissues. Meanwhile, most orthopedic trauma surgeons abandoned the belief that talus fractures are operative emergencies.²⁶ In contrast, a delayed-staged surgery protocol is indicated in case of open wounds, skin necrosis, compromised soft-tissues, or neurovascular injury.⁴ In our series, the surgeon who performed definitive surgery and the timing of surgery were not significantly associated.

In accordance with the literature, patients with talar body fractures reported the worst outcome scores and showed the highest osteoarthritis rate.¹¹ Sneppen 5 fractures had the worst outcome scores, and all these patients had complications. Improvements in operative techniques have led to a progressive decline of postoperative complications.²⁷ We found that SOS was associated with lower osteoarthritis rates, more specifically other peritalar than ankle osteoarthritis, whereas three-fourths of all patients treated with K-wires alone developed osteoarthritis.

Fournier et al¹³ also described higher osteoarthritis rates and less stability using K-wire fixation compared to screw osteosynthesis (SOS). Although K-wire fixation is often used for the treatment of comminuted talus fractures, recent studies advocate here the use of plate and screw osteosynthesis (PSOS), because it might better maintain the talus length.^{12,13} In our study, 1 of 7 patients treated with PSOS did not return to his daily activities. In contrast, after primary arthrodesis (n = 6), only 1 patient returned to his daily activities and we measured significantly worse SF-36 PCS scores. Therefore, it is better to limit primary arthrodesis to cases of comminuted fractures with destruction of the respective joint.²⁷ The chosen operative approach had little effect on the outcome in our series.

There were also no differences in complication rates in any of the postoperative complications measured, except for articular incongruence, which was associated with a posteromedial approach, and the rates were significantly lower in an anterolateral approach. Moreover, a medial osteotomy was associated with higher ankle osteoarthritis rates. However, this finding is likely confounded, because fractures requiring a medial osteotomy (ie, talus dome fractures) are often severe injuries that affect the articulation of the ankle, rather than the medial osteotomy itself.

Like every clinical study, this study has some limitations, including the retrospective design and multiple treatment methods by multiple surgeons. Moreover, the clinical and radiologic follow-up differed substantially, which probably led to a lower osteoarthritis ratio. Although relatively large in comparison with previous single-center talus fracture studies,^{5, 6, 11, 14, 15, 23, 25, 28-30} the small sample size did not allow for Bonferroni correction when presenting statistically significant results. Therefore, *P* values should be interpreted with care. To create a study without these limitations, we suggest conducting a long-term prospective multicenter study in the future.

In conclusion, we found that the long-term results after operative management of talus fractures are disappointing. Particularly, talus body fractures have a poor prognosis. Talus fractures are rare and our results show better outcome when operative management was performed by an experienced surgeon. Therefore, we advise a low threshold for referral to a trauma center, where these fractures are managed by a dedicated surgeon. The long-term outcome was most affected by osteoarthritis. In general, osteoarthritis is largely unmodifiable. Because postoperative articular incongruence was an important predictor for the occurrence of osteoarthritis, strong efforts should be made to prevent articular incongruence postoperatively, to optimize the outcome. Definitive surgery using exclusively K-wire fixation and primary arthrodesis should be avoided. We recommend reviewing the quality of the reduction postoperatively on CT. Furthermore, immediate definitive surgery is not recommended, because talus fractures are often associated with soft tissue complications; operative delay did not increase the risk of AVN, and delay of surgery was associated with better outcome in our study.

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Supplementary Material

Supplemental appendices are available online with this article.

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Figures

Figure 1. Inclusion process and responding patients.

Figure 2. General health status. Mean SF-36 subscale and component summary scores are displayed for responding patients, and the US general population. The subscale scores are ordered according to their contribution to the PCS (left) and the MCS (right) scores. US mean values are derived from Ware et al.³⁶ BP, bodily pain; GH, general health; MCS, Mental Component Summary; MH, mental health; PCS, Physical Component Summary; PF, physical function; RE, role emotional; RP, role physical; SF, social function; SF-36, Short Form 36; US, United States; VT, vitality.

Figure 3. Gustilo grade outcome scores. The mean outcome scores for each Gustilo grade are displayed for all talus fractures in responding patients. Four patients had Gustilo grade 3 (1/65 Gustilo 3a, 2/65 Gustilo 3b, 1/65 Gustilo 3c). FFI, Foot Function Index; MCS, Mental Component Summary; NRS, numeric rating scale; PCS, Physical Component Summary; SF-36, Short Form 36.

Figure 4. Survival curve with secondary arthrodesis as the event of interest.

Figure 5. Talar body fractures outcome scores. The mean outcome scores for each type of body fracture are displayed for all talus fractures in responding patients. Body fractures are classified according to Sneppen et al.³¹ Combined body fracture types are Sneppen 2 and/or Sneppen 3 and/or Sneppen 4 fractures. FFI, Foot Function Index; MCS, Mental Component Summary; NRS, numeric rating scale; PCS, Physical Component Summary; SF-36, Short Form 36.

Figure 6. A 48-year-old patient had a talus fracture after fall from a height. The patient was transferred from regional hospital to our department after application of an external fixator. Preoperative CT showed a comminuted talonavicular subluxation fracture (A, left sagittal view, right axial view). The talus fracture was classified as Hawkins type 4 neck fracture and a Sneppen type 5 body fracture. The fractures were treated using a screw osteosynthesis (SOS) via an osteotomy of the medial malleolus, dual (posteromedial and anteromedial) approach; to re-create the length, the talonavicular joint was bridged (B, left sagittal view, right coronal view). CT at 3 months showed adequate restoration of tibiotalar and talonavicular; however, there was marked subtalar incongruence (ie, articular damage and subluxation) (C, left sagittal view, right axial view). At 12 months postoperatively, there is a nonunion of the talus with signs of avascular necrosis, incongruence of both the tibiotalar and subtalar joint on SPECT-CT (D, left sagittal view, right coronal view). A pantalar arthrodesis will be planned in the near future. CT, computed tomography; SPECT, single-photon emission computed tomography.

Table 1. Demographic, Clinical, and Radiologic Characteristics.^a

Demographics		
Age, y, mean (median)	36.9 (33.0)	
Gender		
Male	65 (77.4)	
Female	19 (22.6)	
ASA score		(i = 4)
1	55 (68.8)	
2	21 (26.3)	
3	2 (2.5)	
4	2 (2.5)	
BMI, mean (median)	24.6 (24.1)	(i = 2)
Smoking	23 (27.4)	
Daily alcohol use	16 (19.0)	
Diabetes mellitus	2 (2.4)	
Other CVRF	17 (20.2)	
Fracture type		
Body fracture	59 (70.2)	(i = 1)
Neck fracture	35 (41.7)	(i = 1)
Head fracture	13 (15.5)	(i = 1)
Associated fractures same foot or ankle	51 (60.0)	
Open fracture	16 (18.8)	
Gustilo 1 1 (1.2)	1 (1.2)	
Gustilo 2	9 (10.6)	
Gustilo 3a	2 (2.4)	
Gustilo 3b	3 (3.5)	
Gustilo 3c	1 (1.2)	
Time of treatment		
Early surgery	13 (15.5)	(i = 1)
Delayed surgery	54 (64.3)	(i = 1)
Delayed-staged surgery	17 (20.2)	(i = 1)
Delayed(-staged) time, d, mean (median)	8.6 (5.0)	(i = 1)
Type of definite surgery		
SOS	46 (54.1)	
PSOS	9 (10.6)	
K-wiring	15 (17.6)	
CREF	7 (8.2)	
Primary arthrodesis	8 (9.4)	
Talus transplant	1 (1.2)	
Operative approach		
Anterior	1 (1.2)	

Table 1. (continued)

Anteromedial	44 (51.8)
Anterolateral	33 (38.8)
Posteromedial	14 (16.5)
Posterolateral	10 (11.8)
Dual approach	16 (18.8)
Medial malleolus osteotomy	6 (7.1)
Lateral malleolus osteotomy	1 (1.2)
Postoperative complication rate	48 (56.5)
Operative site infection	4 (4.7)
Nonunion	15 (24.2)
Intra-articular incongruence	18 (22.8)
AVN	11 (12.9)
Osteoarthritis	36 (42.4)
Ankle osteoarthritis	18 (21.2)
Other peritalar osteoarthritis	29 (34.1)
Other postoperative complications	8 (9.4)
Reintervention rate	39 (45.9)
Material removal	26 (30.6)
Secondary arthrodesis	12 (14.1)
Other reintervention	12 (14.1)

Abbreviations: ASA, American Society of Anesthesiologists; AVN, avascular necrosis; BMI, body mass index; CREF, closed reduction and external fixation; CVRF, cardiovascular risk factors; PSOS, plate and screw osteosynthesis; SOS, screw osteosynthesis. ^aContinuous parameters are expressed as mean (median) values; the rest are n (%). Demographic percentages are displayed per total patients (n = 84 – i). All other percentages are displayed per total talus fractures (n = 85 – i), with i = the number of missing data.

Table 2. Outcome Measures.^a

FFI Total	29.43	
FFI Pain score	30.22	
FFI Disability score	28.67	
NRS Pain	3.20	(i = 3)
SF-36		(i = 4)
PCS	42.71	
MCS	48.29	
Return to daily activity, n (%)	39 (59.1)	

Abbreviations: FFI, Foot Function Index; MCS, Mental Component Summary; NRS, numeric rating scale; PCS, Physical Component Summary; SF-36, Short Form 36. ^aContinuous parameters are expressed as mean values. Percentages are displayed per total responding patients (n = 66 – i), with i = the number of missing data.

Table 3. Correlation Analysis.^a

	FFI Pain	FFI Disability	NRS Pain	SF-36 PCS	SF-36 MCS	Return to Daily Activity
Demographics						
Age *	0.007	0.036	0.001	0.002	0.001	0.057
Male gender	0.002	0.004	0.025	0.003	0.013	0.002
ASA	0.062*	0.042	0.113**	0.016	0.010	0.003
CVRF	<0.001	0.002	0.001	0.003	0.015	0.019
BMI *	0.032	0.033	0.019	0.099*	0.004	<0.001
Smoking	0.004	0.012	0.003	0.009	<0.001	0.018
Daily alcohol	0.011	0.009	0.013	0.003	<0.001	0.024
Diabetes	0.007	0.001	0.006	<0.001	0.021	0.043
Other CVRF	0.001	0.015	0.007	0.033	0.014	0.003
Fracture type						
Body fracture	0.131**	0.095*	0.133**	0.072*	0.154**	0.007
Neck fracture	0.012	0.019	0.015	0.015	0.024	0.003
Head fracture	0.050	0.024	0.051	0.060	0.030	0.095*
Associated fractures same foot or ankle	0.006*	0.054	0.094*	0.005	0.002	0.050
Open fracture	0.045	0.064*	0.037	0.052	0.030	0.114*
Gustillo grade	0.049	0.070*	0.042	0.059	0.023	0.120*
Time of treatment						
Early surgery	0.024	0.020	0.007	0.045	0.031	0.153**
Delayed surgery	0.083*	0.134**	0.041	0.200***	<0.001	0.248***
Delayed-staged surgery	0.040	0.092*	0.028	0.111**	0.026	0.062
Delayed(-staged) time *	<0.001	0.013	0.001	0.015	0.008	<0.001
Type of definite surgery						
SOS	0.062*	0.110**	0.082*	0.144**	0.004	0.084*
PSOS	0.025	0.000	0.009	<0.001	0.002	0.034
K-wiring	0.067*	0.045	0.089*	0.058	0.011	0.013
CREF	0.020	0.008	0.002	<0.001	0.001	0.039
Prim. arthrodesis	0.012	0.046	0.031	0.130**	0.027	0.105*
Operative approach						
Anteromedial	0.015	0.004	0.034	0.046	0.002	0.131*
Anterolateral	0.008	0.017	0.008	0.000	0.038	0.039
Posteromedial	0.002	0.018	0.001	0.024	<0.001	0.024
Posterolateral	0.052	0.017	0.080*	0.043	0.051	0.001
Dual approach	0.030	0.100*	0.023	0.096*	0.037	0.179**
Medial malleolus osteotomy	0.041	0.044	0.004	0.017	0.027	0.018
Postoperative complications						
Postoperative complication	0.248***	0.244***	0.296***	0.181***	<0.001	0.223***
Operative site infection	0.017	0.025	0.018	0.024	0.012	0.114*
Articular incongruence	0.081*	0.076*	0.112**	0.110**	0.016	0.041
Nonunion	0.078*	0.097*	0.104*	0.022	0.001	0.072
AVN	0.044	0.070*	0.038	0.052	0.025	0.062
Osteoarthritis	0.262***	0.236***	0.231***	0.228***	0.021	0.208***
Ankle osteoarthritis	0.135**	0.164***	0.063*	0.174***	0.003	0.175**
Other peritalar osteoarthritis	0.202***	0.180***	0.200***	0.084*	0.030	0.128*
Other complications	0.001	0.006	<0.001	0.002	0.007	0.001
Reinterventions						
Reintervention	0.032	0.025	0.025	0.047	0.002	0.036
Number of reinterventions *	0.026	0.026	0.020	0.052	0.001	0.109*

Abbreviations: ASA, American Society of Anesthesiologists; AVN, avascular necrosis; BMI, body mass index; CREF, closed reduction and external fixation; CVRF, cardiovascular risk factors; FFI, Foot Function Index; MCS, Mental Component Summary; NRS, numeric rating scale; PCS, Physical Component Summary; PSOS, plate and screw osteosynthesis; SF-36, Short Form 36; SOS, screw osteosynthesis. ^aCorrelations were noted as R^2 values. Pearson correlation was used whenever both the outcome parameter and the predicting parameter are continuous. Outcome parameters are all continuous except return to daily activity. The predicting parameters are marked * if they are continuous. Spearman correlation was used whenever the predicting parameter is not continuous. For return to daily activity, the logistic regression with Nagelkerke R^2 was used. If marked *, **, or ***, the correlation model is significant at the 0.05, 0.01, or 0.001 level, respectively. Underscored are all R^2 values of those characteristics that lead to a better outcome when present (for binominal parameters) or with increasing number (for multinominal or continuous parameters).

Long-term outcome after operative management of talus fractures: what have we learned? - ADDENDA

TABLE OF CONTENTS

Addendum I: Hawkins classification	p.2
Addendum II: Sneppen classification	p.2
Addendum III: Supplementary tables	p.3
Supplementary table 1	p.3
Supplementary table 2	p.4
Supplementary table 3	p.5
Supplementary table 4	p.6
Supplementary table 5	p.7
Supplementary table 6	p.10
Supplementary table 7	p.11
Supplementary table 8	p.12
Supplementary table 9	p. 12
Addendum IV: Questionnaire	p.13

ADDENDUM I: HAWKINS CLASSIFICATION MODIFIED BY CANALE AND KELLY⁵

Type 1: Undisplaced talar neck fracture

Type 2: Displaced talar neck fracture with subluxation or dislocation of the subtalar joint

Type 3: Displaced talar neck fracture with subluxation or dislocation of the subtalar and ankle joints

Type 4: Displaced talar neck fracture with subluxation or dislocation of the subtalar, ankle and talonavicular joints.

ADDENDUM II: SNEPPEN CLASSIFICATION³¹

Type 1: Transchondral talar body fracture

Type 2: Sagittal, coronal or horizontal talar body fracture

Type 3: Processus posterior fracture of the talus

Type 4: Processus lateralis fracture of the talus

Type 5: Crush fracture of the talar body

ADDENDUM III: SUPPLEMENTARY TABLES

Supplementary table 1. Demographic, clinical and radiological characteristics

	All patients	Responders	Responders VS Nonresponders
Demographics			
Age (years)	36.86 (33.00)	39.46 (35.50)	0.106 (MWU)
Gender			0.060 (FE)
Male	65 (77.4%)	48 (72.7%)	
Female	19 (22.6%)	18 (27.3%)	
ASA-score			0.039 (Chi ²) *
1	55 (68.8%)	45 (71.4%)	P > 0.05
2	21 (26.3%)	16 (25.4%)	P > 0.05
3	2 (2.5%)	0 (0%)	P < 0.05 *
4	2 (2.5%)	2 (3.2%)	P > 0.05
BMI (kg/m ²)	24.59 (24.10)	24.67 (24.20)	0.391 (MWU)
Smoking	23 (27.4%)	18 (27.3%)	1.000 (FE)
Daily alcohol use	16 (19.0%)	12 (18.2%)	0.739 (FE)
Diabetes mellitus	2 (2.4%)	2 (3.0%)	1.000 (FE)
Other CVRF	17 (20.2%)	16 (24.2%)	0.104 (FE)
Fracture type			
Body fracture	59 (70.2%)	47 (71.2%)	0.708 (Chi ²)
Neck fracture	35 (41.7%)	30 (45.5%)	0.178 (Chi ²)
Head fracture	13 (15.5%)	10 (15.2%)	1.000 (FE)
Associated fractures same foot or ankle	51 (60.0%)	40 (59.7%)	0.914 (Chi ²)
Open fracture	16 (18.8%)	13 (19.4%)	1.000 (FE)
<u>Gustilo 1</u>	<u>1 (1.2%)</u>	<u>1 (1.5%)</u>	<u>0.798 (Chi²)</u>
<u>Gustilo 2</u>	<u>9 (10.6%)</u>	<u>8 (11.9%)</u>	
<u>Gustilo 3a</u>	<u>2 (2.4%)</u>	<u>1 (1.5%)</u>	
<u>Gustilo 3b</u>	<u>3 (3.5%)</u>	<u>2 (3.0%)</u>	
<u>Gustilo 3c</u>	<u>1 (1.2%)</u>	<u>1 (1.5%)</u>	
Time of treatment			
Early surgery	13 (15.5%)	10 (15.2%)	1.000 (FE)
Delayed surgery	54 (64.3%)	41 (62.1%)	0.428 (Chi ²)
Delayed-staged surgery	17 (20.2%)	15 (22.7%)	0.343 (FE)
Delayed(-staged) time (days)	8.56 (5.00)	9.22 (6.00)	0.149 (MWU)
Type of definite surgery			
SOS	46 (54.1%)	36 (53.7%)	0.890 (Chi ²)
PSOS	9 (10.6%)	7 (10.4%)	1.000 (FE)
K-wiring	15 (17.6%)	12 (17.9%)	1.000 (FE)
CREF	7 (8.2%)	6 (9.0%)	1.000 (FE)
Arthrodesis	8 (9.4%)	6 (9.0%)	0.675 (FE)
Talar transplant	1 (1.2%)	1 (1.5%)	1.000 (FE)
Surgical approach			0.977 (Chi ²)
<u>Anterior</u>	<u>1 (1.2%)</u>	<u>1 (1.2%)</u>	
<u>Anteromedial</u>	<u>44 (51.8%)</u>	<u>35 (41.2%)</u>	
<u>Anterolateral</u>	<u>33 (38.8%)</u>	<u>26 (30.6%)</u>	
<u>Posteromedial</u>	<u>14 (16.5%)</u>	<u>12 (14.1%)</u>	
<u>Posterolateral</u>	<u>10 (11.8%)</u>	<u>8 (9.4%)</u>	
<u>Dual approach</u>	<u>16 (18.8%)</u>	<u>14 (20.9%)</u>	0.504 (FE)
<u>Medial malleolus osteotomy</u>	<u>6 (7.1%)</u>	<u>5 (7.5%)</u>	0.148 (FE)
<u>Lateral malleolus osteotomy</u>	<u>1 (1.2%)</u>	<u>0 (0%)</u>	

Postoperative complication rate	48 (56.5%)	41 (61.2%)	0.112 (Chi ²)
Surgical site infection	4 (4.7%)	3 (4.5%)	1.000 (FE)
Nonunion	15 (24.2%)	14 (27.5%)	0.268 (FE)
Intra-articular incongruence	18 (22.8%)	14 (21.2%)	0.479 (FE)
AVN	11 (12.9%)	9 (13.4%)	1.000 (FE)
Osteoarthritis	36 (42.4%)	30 (44.8%)	0.383 (Chi ²)
Ankle osteoarthritis	7 (8.2%)	6 (9.0%)	0.850 (Chi ²)
Other peritalar osteoarthritis	18 (21.2%)	15 (22.4%)	
Both ankle and other peritalar osteoarthritis	11 (12.9%)	9 (13.4%)	
Other postoperative complications	8 (9.4%)	7 (10.4%)	1.000 (FE)
Reintervention rate	39 (45.9%)	33 (49.3%)	0.229 (Chi ²)
Material removal	26 (30.6%)	21 (31.3%)	0.771 (Chi ²)
Arthrodesis	12 (14.1%)	11 (16.4%)	0.446 (FE)
Other reintervention	12 (14.1%)	11 (16.4%)	0.446 (FE)

Continuous parameters are expressed as mean (median) values. Demographic percentages are displayed per total patients (all patients, n=84-i and responders, n = 66-i). All other percentages are displayed per total talus fractures (all patients, n=85-i and responders, n = 67-i) With i = the number of missing data. Differences between responders and nonresponders for these values were displayed as: p-value (statistical test). Statistically significant values are marked *

Abbreviations: ASA, American Society of Anesthesiologists; BMI, Body Mass Index; CVRF, cardiovascular risk factors; SOS, screw osteosynthesis; PSOS, plate and screw osteosynthesis; CREF, closed reduction and external fixation; AVN, avascular necrosis; MWU, Mann Withney U test; Chi², Pearson Chi-Square test; FE, Fisher's Exact test.

Supplementary table 2. Median outcome scores

FFI Total	23.0 (10.0-48.0)
FFI Pain	29.0 (11.0-46.0)
FFI Disability	22.0 (6.0-47.0)
NRS Pain	3.0 (1.0-5.0)
SF-36	
PCS	44.0 (32.5-52.9)
MCS	52.0 (42.1-55.6)
Return to daily activity	39 (60.0%)

Continuous parameters are expressed as median values with their respective interquartile range. Percentages are displayed per total responding patients (n=66-i). With i = the number of missing data. Abbreviations: FFI, Foot Function Index; NRS, Numeric Rating Scale; SF-36, Short Form 36; PCS, Physical Component Summary; MCS, Mental Component Summary.

Supplementary table 3. Median outcome scores for Sneppen classification

	FFI Pain	FFI Disability	NRS Pain	SF36 PCS	SF36 MCS
Sneppen2	14.0 (4.0-61.0)	9.0 (0.0-34.0)	4.0 (0.0-7.0)	52.5 (44.7-58.8)	51.8 (44.7-52.1)
Sneppen 3	32.5 (26.0-45.3)	27.0 (22.8-43.8)	5.0 (3.0-5.0)	33.0 (26.7-40.6)	52.5 (49.6-56.6)
Sneppen 4	21.0 (14.0-57.0)	16.0 (3.0-50.0)	3.0 (0.0-7.0)	49.9 (32.5-57.4)	<u>37.4</u> (25.4-53.7)
Combined FX	31.0 (10.0-48.0)	29.5 (9.0-54.5)	3.0 (2.0-7.0)	42.0 (28.4-52.9)	46.6 (35.5-55.5)
Sneppen 5	<u>64.5</u> (38.5-76.8)	<u>76.5</u> (47.5-83.5)	<u>6.0</u> (3.5-7.0)	<u>23.5</u> (19.3-33.0)	42.1 (32.8-51.6)
No body fracture	11.0 (0.0-30.0)	13.0 (0.0-34.0)	1.0 (0.0-4.0)	47.5 (42.6-56.5)	55.5 (52.5-58.2)

Numbers are expressed as median values with their respective interquartile range. Worst scorings are underlined. Abbreviations: FFI, Foot Function Index; NRS, Numeric Rating Scale; SF-36, Short Form 36; PCS, Physical Component Summary; MCS, Mental Component Summary. Combined body fracture types are Sneppen 2 and/or Sneppen 3 and/or Sneppen 4 fractures.

Supplementary table 4. Foot Function Index; descriptives for all questions

Pain	<u>No pain</u>	<u>Some pain</u>	<u>Considerable pain</u>	<u>Severe pain</u>	<u>Unbearable pain</u>	<u>Not applicable</u>	<u>Missing</u>
B1 At its worst	12 (18.2%)	19 (28.8%)	16 (24.2%)	14 (21.2%)	5 (7.6%)	0	0
B2 Before you get up in the morning	33 (50.0%)	18 (27.3%)	7 (10.6%)	8 (12.1%)	0	0	0
B3 When you walked without shoes	17 (25.8%)	21 (31.8%)	13 (19.7%)	9 (13.6%)	3 (4.5%)	3 (4.5%)	0
B4 When you stood without shoes	27 (40.9%)	16 (24.2%)	13 (19.7%)	4 (6.1%)	2 (3.0%)	3 (4.5%)	1 (1.5%)
B5 When you walked wearing shoes	20 (30.3%)	23 (34.8%)	12 (18.2%)	8 (12.1%)	1 (1.5%)	1 (1.5%)	1 (1.5%)
B6 When you stood wearing shoes	30 (45.5%)	22 (33.3%)	9 (13.6%)	5 (7.6%)	0	0	0
B7* When you walked wearing custom shoe inserts	10 (15.2%)	11 (16.7%)	6 (9.1%)	4 (6.1%)	0	34 (51.5%)	1 (1.5%)
B8* When you stood wearing custom shoe inserts	12 (18.2%)	13 (19.7%)	5 (7.6%)	3 (4.5%)	0	33 (50.0%)	0
B9 At the end of the day	17 (25.8%)	20 (30.3%)	11 (16.7%)	16 (24.2%)	2 (3.0%)	0	0
Disability	<u>No difficulty</u>	<u>Some difficulty</u>	<u>Considerable difficulty</u>	<u>Severe difficulty</u>	<u>Impossible</u>	<u>Not applicable</u>	<u>Missing</u>
C1 Walking around inside your house	34 (51.5%)	19 (28.8%)	10 (15.2%)	3 (4.5%)	0	0	0
C2 Walking outside on uneven ground	15 (22.7%)	22 (33.3%)	16 (24.2%)	9 (13.6%)	4 (6.1%)	0	0
C3 Walking 500m or more	27 (40.9%)	13 (19.7%)	13 (19.7%)	8 (12.1%)	5 (7.6%)	0	0
C4 Climbing stairs	26 (39.4%)	19 (28.8%)	9 (13.6%)	9 (13.6%)	3 (4.5%)	0	0
C5 Descending stairs	23 (34.8%)	18 (27.3%)	10 (15.2%)	11 (16.7%)	4 (6.1%)	0	0
C6 Standing on tip toes	21 (31.8%)	14 (21.2%)	8 (12.1%)	11 (16.7%)	10 (15.2%)	2 (3.0%)	0
C7 Getting out of a chair	39 (59.1%)	10 (15.2%)	10 (15.2%)	6 (9.1%)	1 (1.5%)	0	0
C8 Walking up or down a curb	32 (48.5%)	19 (28.8%)	9 (13.6%)	5 (7.6%)	0	1 (1.5%)	0
C9* Walking fast	10 (15.2%)	11 (16.7%)	9 (13.6%)	7 (10.6%)	27 (40.9%)	2 (3.0%)	0

Percentages are displayed according to total responders (n=66). *As advised by Kuyvenhoven et al., these values were not considered when computing the total FFI pain, FFI disability and FFI total scores.²²

Supplementary tabel 5. SF36; descriptives for all questions

GH 1 In general, would you say your health is:	<u>Excellent</u> 6 (9.1%)	<u>Very good</u> 18 (27.3%)	<u>Good</u> 31 (47.0%)	<u>Moderate</u> 11 (16.7%)	<u>Bad</u> 0	<u>Missing</u> 0
HC 1 Compared with one year ago, how would you rate your health in general now?	<u>A lot better</u> 5 (7.6%)	<u>A little better</u> 9 (13.6%)	<u>The same</u> 45 (68.2%)	<u>A little worse</u> 7 (10.6%)	<u>A lot worse</u> 0	<u>Missing</u> 0
<u>Does your health now limit you in following activities?</u>	<u>Yes</u>	<u>A little</u>	<u>No</u>			<u>Missing</u>
PF 1 During vigorous activities, such as running, lifting heavy objects, participating in strenuous sports.	38 (57.6%)	21 (31.8%)	6 (9.1%)			1 (1.5%)
PF 2 During moderate activities, such as moving a table, pushing a vacuum cleaner, cycling.	11 (16.7%)	26 (39.4%)	28 (42.4%)			1 (1.5%)
PF 3 Lifting or carrying groceries	9 (13.6%)	26 (39.4%)	31 (47.0%)			0
PF 4 Climbing several flights of stairs	16 (24.2%)	25 (37.9%)	24 (36.4%)			1 (1.5%)
PF 5 Climbing one flight of stairs	9 (13.6%)	25 (37.9%)	31 (47.0%)			1 (1.5%)
PF 6 Bending over, kneeling, squatting	16 (24.2%)	35 (53.0%)	14 (21.2%)			1 (1.5%)
PF 7 Walking over 1 kilometer	21 (31.8%)	18 (27.3%)	26 (39.4%)			1 (1.5%)
PF 8 Walking a few hundred meters	10 (15.2%)	20 (30.3%)	35 (53.0%)			1 (1.5%)
PF 9 Walking around 100 meters	8 (12.1%)	17 (25.8%)	40 (60.8%)			1 (1.5%)
PF 10 Washing yourself or getting dressed	5 (7.6%)	9 (13.6%)	52 (78.8%)			0
<u>Has your physical health limited you last 4 weeks?</u>	<u>Yes</u>	<u>No</u>				<u>Missing</u>
RP 1 Cut down the amount of time you spent on work or other activities	18 (27.3%)	45 (68.2%)				3 (4.5%)
RP 2 Accomplished less than you would like	28 (42.4%)	35 (53.0%)				3 (4.5%)
RP 3 Were limited in the kind of work or other activities	27 (40.9%)	37 (56.1%)				2 (3.0%)
RP 4 Had difficulty performing the work or other activities	27 (40.9%)	36 (54.5%)				3 (4.5%)

<u>Has your emotional health limited you last 4 weeks? (such as feeling depressed or anxious)</u>	<u>Yes</u>	<u>No</u>					<u>Missing</u>
RE 1 Cut down the amount of time you spent on work or other activities	12 (18.2%)	50 (75.8%)					4 (6.1%)
RE 2 Accomplished less than you would like	21 (31.8%)	42 (63.6%)					3 (4.5%)
RE 3 Didn't do work or other activities as carefully as usual	15 (22.7%)	48 (72.7%)					3 (4.5%)
SF1 Did your emotional problems interfere with your normal social activities with family, friends, neighbours, or groups?	<u>Totally not</u> 29 (43.9%)	<u>Slightly</u> 22 (33.3%)	<u>Quite</u> 5 (7.6%)	<u>A lot</u> 3 (4.5%)	<u>Very much</u> 5 (7.6%)		<u>Missing</u> 2 (3.0%)
BP 1 How much bodily pain have you had during the past 4 weeks?	<u>None</u> 10 (15.2%)	<u>Very light</u> 15 (22.7%)	<u>Light</u> 13 (19.7%)	<u>Quite</u> 14 (21.2%)	<u>Severe</u> 12 (18.2%)	<u>Very severe</u> 2 (3.0%)	<u>Missing</u> 0
BP 2 During the past 4 weeks, how much did pain interfere with your normal work (including both work outside the home and housework)?	<u>Totally not</u> 18 (27.3%)	<u>A little</u> 23 (34.8%)	<u>Quite</u> 10 (15.2%)	<u>A lot</u> 8 (12.1%)	<u>Very much</u> 7 (10.6%)		<u>Missing</u> 0
<u>During the last 4 weeks, how often did you feel:</u>	<u>Always</u>	<u>Most of the time</u>	<u>Often</u>	<u>Sometimes</u>	<u>Seldom</u>	<u>Never</u>	<u>Missing</u>
VT 1 canty	12 (18.2%)	26 (39.4%)	9 (13.6%)	7 (10.6%)	6 (9.1%)	3 (4.5%)	3 (4.5%)
MH 1 nervous	<u>Never</u> 8 (12.1%)	<u>Seldom</u> 25 (37.9%)	<u>Sometimes</u> 25 (37.9%)	<u>Often</u> 5 (7.6%)	<u>Most of the time</u> 1 (1.5%)	<u>Always</u> 0	<u>Missing</u> 2 (3.0%)
MH 2 nothing could cheer you up	32 (48.5%)	12 (18.2%)	14 (21.2%)	5 (7.6%)	1 (1.5%)	0	2 (3.0%)
MH 3 calm and relaxed	<u>Always</u> 7 (10.6%)	<u>Most of the time</u> 17 (25.8%)	<u>Often</u> 12 (18.2%)	<u>Sometimes</u> 21 (31.8%)	<u>Seldom</u> 7 (10.6%)	<u>Never</u> 0	<u>Missing</u> 2 (3.0%)
VT 2 energetic	6 (9.1%)	13 (19.7%)	17 (25.8%)	14 (21.2%)	11 (16.7%)	2 (3.0%)	3 (4.5%)

MH 4 sad	<u>Never</u> 16 (24.2%)	<u>Seldom</u> 20 (30.3%)	<u>Sometimes</u> 18 (30.3%)	<u>Often</u> 7 (10.6%)	<u>Most of the time</u> 1 (1.5%)	<u>Always</u> 0	<u>Missing</u> 4 (6.1%)
VT 3 exhausted	8 (12.1%)	18 (27.3%)	26 (39.4%)	6 (9.1%)	4 (6.1%)	1 (1.5%)	3 (4.5%)
MH 5 happy	<u>Always</u> 6 (9.1%)	<u>Most of the time</u> 31 (47.0%)	<u>Often</u> 7 (10.6%)	<u>Sometimes</u> 12 (18.2%)	<u>Seldom</u> 7 (10.6%)	<u>Never</u> 0	<u>Missing</u> 3 (4.5%)
VT 4 tired	<u>Never</u> 3 (4.5%)	<u>Seldom</u> 10 (15.2%)	<u>Sometimes</u> 22 (33.3%)	<u>Often</u> 16 (24.2%)	<u>Most of the time</u> 9 (13.6%)	<u>Always</u> 3 (4.5%)	<u>Missing</u> 3 (4.5%)
SF 2 During the last 4 weeks, how often did your physical or emotional problems limit you in your social activities (such as visiting friends or family)	<u>Always</u> 1 (1.5%)	<u>Most of the time</u> 5 (7.6%)	<u>Sometimes</u> 16 (24.2%)	<u>Seldom</u> 17 (25.8%)	<u>Never</u> 27 (40.9%)		<u>Missing</u> 0
GH 2 I seem to get sick more easily than other people	<u>Completely correct</u> 1 (1.5%)	<u>Mostly correct</u> 7 (10.6%)	<u>I don't know</u> 5 (7.6%)	<u>Mostly incorrect</u> 16 (24.2%)	<u>Completely incorrect</u> 35 (53.0%)		<u>Missing</u> 2 (3.0%)
GH 3 I am as healthy as other people I know	<u>Completely incorrect</u> 3 (4.5%)	<u>Mostly incorrect</u> 12 (18.2%)	<u>I don't know</u> 8 (12.1%)	<u>Mostly correct</u> 24 (36.4%)	<u>Completely correct</u> 18 (27.3%)		<u>Missing</u> 1 (1.5%)
GH 4 I expect my health to deteriorate	<u>Completely correct</u> 3 (4.5%)	<u>Mostly correct</u> 11 (16.7%)	<u>I don't know</u> 34 (51.5%)	<u>Mostly incorrect</u> 6 (9.1%)	<u>Completely incorrect</u> 10 (15.2%)		<u>Missing</u> 2 (3.0%)
GH 5 My health is excellent	<u>Completely incorrect</u> 6 (9.1%)	<u>Mostly incorrect</u> 12 (18.2%)	<u>I don't know</u> 7 (10.6%)	<u>Mostly correct</u> 30 (45.5%)	<u>Completely correct</u> 10 (15.2%)		<u>Missing</u> 1 (1.5%)

Percentages are displayed according to total responders (n=66).

Supplementary table 6. Intercorrelation of the outcome measures

	FFI Pain	FFI Disability	NRS Pain	SF-36 PCS	SF-36 MCS	Return to daily activity §
FFI Pain	1	0.837***	0.850***	-0.714***	-0.377**	0.504***
FFI Disability	0.837***	1	0.771***	-0.782***	-0.299*	0.600***
NRS Pain	0.850***	0.771***	1	-0.708***	-0.342**	0.382**
SF-36 PCS	-0.714***	-0.782***	-0.708***	1	0.174	-0.474***
SF-36 MCS	-0.377**	-0.299*	-0.342**	0.174	1	-0.028
Return to daily activity §	0.504***	0.600***	0.382**	-0.474***	-0.028	1

Correlations were noted as r- values. Pearson correlation was used whenever both parameters are continuous. Nominal parameters are marked §. Spearman correlation was used when one of the parameters is not continuous.

If marked *, **, or ***, the correlation model is statistically significant at the 0.05, 0.01 or 0.001 level respectively.

Abbreviations: FFI, Foot Function Index; VAS, Visual Analog Scale; SF-36, Short Form 36; PCS, Physical Component Summary; MCS, Mental Component Summary.

Supplementary table 7. Stepwise multiple regression analysis

	Model parameters	Unstandardised coefficients			Model values		
		Beta	SE	p-value	r	R ²	p-value
FFI Pain	Constant	10.715	4.628	0.025	0.644	0.414	5*10 ⁻⁶
	Osteoarthritis	24.482	5.737	0.000			
	Body fracture	13.745	5.856	0.023			
FFI Disability	Constant	25.831	6.266	0.000	0.640	0.409	15*10 ⁻⁶
	Osteoarthritis	21.638	6.215	0.001			
	Delayed surgery	-14.953	6.256	0.021			
	Nonunion	14.112	6.579	0.037			
NRS Pain	Constant	0.847	0.505	0.101	0.638	0.408	13*10 ⁻⁶
	Postoperative complications	2.24	0.596	0.001			
	Body fracture	1.615	0.596	0.010			
SF-36 PCS	Constant	46.274	2.533	0.000	0.715	0.512	2*10 ⁻⁷
	Osteoarthritis	-6.779	2.504	0.009			
	Arthodesis	-14.899	4.176	0.001			
	Articular incongruence	-9.801	2.739	0.001			
SF-36 MCS	Delayed surgery	5.391	2.545	0.039	0.350	0.123	0.005
	Constant	-7.959	2.289	0.000			
	Body fracture	53.762	2.289	0.005			
Return to daily activity	Constant	2.291	0.574	0.000	NA	0.506	5*10 ⁻⁶
	Head fracture	-2.461	0.922	0.008			
	Gustilo grade	-0.877	0.330	0.008			
	Dual approach	-2.325	0.877	0.009			
	Ankle						
	osteoarthritis	-2.032	0.813	0.012			

This table represents an overview of the results obtained from our stepwise multiple regression analysis. For return to daily activity, a logistic regression model was used. For all other outcome parameters, a linear regression model was used. Only the final model is displayed. Abbreviations: SE, standard error; NA, not applicable; FFI, Foot Function Index; VAS, Visual Analog Scale; SF-36, Short Form 36; PCS, Physical Component Summary; MCS, Mental Component Summary.

Supplementary table 8. Fracture classification - Descriptives

Neck fracture*	30 (45.5%)
Hawkins 1	10 (35.7%)
Hawkins 2	13 (46.4%)
Hawkins 3	3 (10.7%)
Hawkins 4	2 (7.1%)
Head fracture*	10 (15.2%)
Hawkins 1	6 (60.0%)
Hawkins 2	1 (10.0%)
Hawkins 3	0 (0%)
Hawkins 4	3 (30.0%)
Body fracture*	47 (71.2%)
Sneppen 1	0 (0.0%)
Sneppen 2	7 (15.2%)
Sneppen 3	8 (17.4%)
Sneppen 4	7 (15.2%)
Combined body fracture types	18 (39.1%)
Sneppen 5	6 (13.0%)

Percentages are displayed per total neck (n = 30-i), head (n = 10-i) or body (n = 47-i) fractures in responding patients. With i = the number of missing data.

*Percentage displayed per total fractures in responding patients (n = 67-i). With i = the number of missing data.

Combined body fracture types are Sneppen 2 and/or Sneppen 3 and/or Sneppen 4 fractures.

Supplementary table 9. Outcome by surgeon that performed definite surgery

Surgeon	FFI Pain	FFI Disability	NRS Pain	SF PCS	SF MCS	Return to daily activity
PR	23.7	25.8	2.5	43.8	49.8	59.5%
Other	35.5	30.1	3.9	42.2	47.0	65.4%
DM	46.9	38.1	5.9	36.1	52.2	66.7%
SN	43.0	29.2	4.2	43.6	41.6	50.0%
HH	28.8	38.3	1.5	46.8	34.0	50.0%
PB	40.3	24.0	3.7	40.3	40.7	100%
GM	7.0	5.3	1.3	51.4	55.8	100%
AS	39.5	44.0	5.5	26.1	47.6	50.0%
Fellow	23.7	24.0	2.3	50.3	57.7	66.7%

The initials of the name of the surgeon are displayed. Surgeons are listed in order of the amount of talus fractures they operated. PR operated 55% of all talus fractures. Only three fractures were operated by a fellow. All other fractures were operated by staff surgeons. Continuous outcome scores are expressed as mean values. Return to daily activity is expressed as a percentage of all patients operated by a certain surgeon. Abbreviations: FFI, Foot Function Index; VAS, Visual Analog Scale; SF-36, Short Form 36; PCS, Physical Component Summary; MCS, Mental Component Summary

ADDENDUM IV: QUESTIONNAIRE

Enquête studie breuken van het sprongbeen

1) Demografische gegevens:

1. Geboortedatum _____ (dd-mm-yyyy)
2. Geslacht ☐ Man
☐ Vrouw
3. Lengte _____cm
4. Gewicht _____kg
5. Rookt u? ☐ Ja, _____aantal sigaretten per dag
☐ Nee
6. Hebt u in het verleden
gerookt? ☐ Nee
☐ Ja, van _____ (leeftijd) tot _____ (leeftijd)
7. Wat voor werk deed u
voordat u het
voet/enkelletsel heeft
opgelopen? _____
_____
_____
8. Wat doet u nu voor werk? ☐ Ik heb dezelfde baan als voor het letsel
☐ Ik heb dezelfde baan, maar met aanpassingen
☐ Ik heb nu een andere baan / ben werkloos (NIET o.w.v. mijn
voet/enkel)
☐ Ik heb nu een andere baan (o.w.v. mijn voet/enkel)
☐ Ik ben (vrijwel) niet meer in staat te werken o.w.v. mijn
voet/enkel
☐ Ik ben gepensioneerd, en mijn voet/enkel hindert mij NIET
bij mijn dagelijkse activiteiten
☐ Ik ben gepensioneerd, en mijn voet/enkel hindert mij bij mijn
dagelijkse activiteiten
10. Welke was uw gebroken
voet/enkel? ☐ Links (u mag vraag 11 overslaan)
☐ Rechts (u mag vraag 11 overslaan)
☐ Beiderzijds
11. Indien beiderzijds
gebroken, welke
voet/enkel heeft u de
meeste klachten? ☐ Links
☐ Rechts

2) Gegevens over de behandeling

1. Hoe lang hebt u gerevalideerd? +/- _____ sessies bij de kiné,
of gedurende: +/- _____ (weken/maanden/jaren)
2. Hoeveel weken heeft u uw voet niet mogen belasten? +/- _____ weken
3. Bent u met een gips of een brace nabehandeld? ☐ Nee
☐ Ja, gedurende _____ weken
4. Bent u in een ander ziekenhuis dan UZ Leuven campus Gasthuisberg of campus Pellenberg geopereerd voor hetzelfde letsel? ☐ Ja
☐ Nee
5. Zo ja, wat is er gebeurd? ☐ Er is een plaat en/of schroeven toegevoegd
- Datum: _____
☐ Er is materiaal verwijderd
- Datum: _____
- Waarom: _____
☐ Er is een prothese geplaatst
- Datum: _____
☐ Andere namelijk: _____

3) Voetpijn en Beperkingen Index

(E. Budiman-Mak et al. 1991, modificatie volgens K.J. Gorter et al.)

Vragenlijst voor mensen met voetklachten

Geachte mevrouw, meneer,

Wij verzoeken u de vragen op de twee volgende pagina's betreffende "Pijn" en "Moeite met activiteiten" te beantwoorden. Met behulp van uw antwoorden kan de behandelend orthopaedisch chirurg het verloop van uw voetklachten beter volgen.

Het invullen van de vragenlijst duurt ongeveer 5 minuten. Leest u voor het invullen eerst de bijgaande instructies.

Hartelijke dank.

Instructies voor het invullen

De vragen hebben betrekking op de gevolgen van **uw voetklachten in de afgelopen week**, op uw dagelijks functioneren.

Streep bij elke vraag het antwoord aan dat het beste bij uw situatie past. Als u niet zeker weet hoe u een vraag moet beantwoorden, geef dan het best mogelijke antwoord.

Voorbeeld:

Als u de afgelopen week, als gevolg van uw voetklachten, slechts *zelden* schoenen droeg wanneer u in huis liep, dan geeft u dat als volgt aan:

<u>Antwoord:</u>	<i>nooit</i>	<i>zelden</i>	<i>af en toe</i>	<i>meestal</i>	<i>altijd</i>	<i>niet van toepassing</i>
<u>Vraag:</u> Hoe vaak droeg u schoenen wanneer u in huis liep?	☐	☒	☐	☐	☐	☐

Het kan voorkomen, dat de uitspraak niet op u van toepassing is, omdat u de afgelopen week in het ziekenhuis opgenomen was en dus niet **binnenshuis** met schoenen kon lopen. U kruist dan het hokje helemaal rechts "**niet van toepassing**" aan.

Voorbeeld:

<u>Antwoord:</u>	<i>nooit</i>	<i>zelden</i>	<i>af en toe</i>	<i>meestal</i>	<i>altijd</i>	<i>niet van toepassing</i>
<u>Vraag:</u> Hoe vaak droeg u schoenen wanneer u in huis liep?	☐	☐	☐	☐	☐	☒

U kruist eveneens "niet van toepassing" aan als u geen schoenen droeg, niet vanwege uw voetklachten maar omdat u bijvoorbeeld griep had.

Op de volgende pagina begint de vragenlijst.

Pijn

Wilt u bij de volgende vragen alleen een antwoord geven, als dit antwoord met uw voetklachten samenhangt; als dat niet het geval is, kruist u “niet van toepassing” aan.

Let op: *Als èèn of meerdere situaties niet voorkwamen (bijvoorbeeld bij vraag B7 en B8: u heeft geen aangepaste zolen), dan kruist u “niet van toepassing” aan.*

Vraag:

Hoeveel pijn had u in de afgelopen week aan uw voet in de volgende situaties?

	Geen pijn	enige pijn	nogal wat pijn	veel pijn	niet te verdragen pijn	niet van toepassing
B1 Toen deze op zijn ergst was?	☐	☐	☐	☐	☐	☐
B2 Voor u uit bed kwam 's morgens?	☐	☐	☐	☐	☐	☐
B3 Bij lopen (= stappen) op blote voeten?	☐	☐	☐	☐	☐	☐
B4 Bij staan op blote voeten?	☐	☐	☐	☐	☐	☐
B5 Bij lopen (= stappen) met schoenen aan?	☐	☐	☐	☐	☐	☐
B6 Bij staan met schoenen aan?	☐	☐	☐	☐	☐	☐
B7 Bij lopen (= stappen) met inlays of aangepaste binnenzolen?	☐	☐	☐	☐	☐	☐
B8 Bij staan met inlays of aangepaste binnenzolen?	☐	☐	☐	☐	☐	☐
B9 Aan het einde van de dag?	☐	☐	☐	☐	☐	☐

Moeite met activiteiten

Wilt u bij de volgende vragen alleen een antwoord geven, als dit antwoord met uw voetklachten samenhangt; als dat niet het geval is, kruist u “niet van toepassing” aan.

Let op: *Als èèn of meerdere situaties niet voorkwamen (bijvoorbeeld bij vraag C2 en C8: u kwam de afgelopen week helemaal niet buiten), dan kruist u “niet van toepassing” aan.*

Vraag:

Hoeveel moeite had u in de afgelopen week, als gevolg van uw voetklachten, om de volgende handelingen uit te voeren?

		Geen moeite	enige moeite	nogal wat moeite	veel moeite	niet toe in staat	niet van toepassing
C1	Binnenshuis lopen (= stappen)?	☐	☐	☐	☐	☐	☐
C2	Buitenshuis lopen (= stappen) op oneffen terrein?	☐	☐	☐	☐	☐	☐
C3	500 meter of meer lopen (= stappen)?	☐	☐	☐	☐	☐	☐
C4	De trap oplopen ?	☐	☐	☐	☐	☐	☐
C5	De trap aflopen ?	☐	☐	☐	☐	☐	☐
C6	Op de tenen staan?	☐	☐	☐	☐	☐	☐
C7	Opstaan uit een stoel?	☐	☐	☐	☐	☐	☐
C8	Een stoeprand op- of afstappen?	☐	☐	☐	☐	☐	☐
C9	Snel lopen (=stappen) of rennen?	☐	☐	☐	☐	☐	☐

4) NRS pijn score

Hoe erg schat u de pijn ter hoogte van uw enkel in op dit moment?
Duid dit aan op onderstaande schaal.

☐ 0   ☐ 1   ☐ 2   ☐ 3   ☐ 4   ☐ 5   ☐ 6   ☐ 7   ☐ 8   ☐ 9   ☐ 10

0   1   2   3   4   5   6   7   8   9   10

Geen pijn   weinig pijn   matige pijn   hevige pijn   zeer hevige pijn

5) Short Form 36 (SF-36)

Deze vragenlijst gaat over uw gezondheid en de invloed van uw gezondheid op uw dagelijks leven. Met behulp van deze gegevens kan worden bijgehouden hoe u zich voelt en hoe goed u in staat bent uw gebruikelijke bezigheden uit te voeren. Wilt u elke vraag beantwoorden door het antwoord te markeren zoals aangegeven? Wanneer u twijfelt over het antwoord op een vraag, probeer dan het antwoord te geven dat het meest van toepassing is.

1. **Wat vindt u, over het algemeen genomen, van uw gezondheid?**
(kruis één antwoord aan)
  - ☐ Uitstekend
  - ☐ Zeer goed
  - ☐ Goed
  - ☐ Matig
  - ☐ Slecht

2. **In vergelijking met een jaar geleden, hoe zou u nu uw gezondheid in het algemeen beoordelen?** (kruis één antwoord aan)
  - ☐ Veel beter dan een jaar geleden
  - ☐ Iets beter dan een jaar geleden
  - ☐ Ongeveer hetzelfde als een jaar geleden
  - ☐ Iets slechter dan een jaar geleden
  - ☐ Veel slechter dan een jaar geleden

3. De volgende vragen gaan over dagelijkse bezigheden. Wordt u door uw gezondheid op dit moment beperkt bij deze bezigheden? Zo ja, in welke mate?

(Kruis één antwoord aan)

BEZIGHEDEN

	Ja, ernstig beperkt	Ja, een beetje beperkt	Nee, helemaal niet beperkt
a Forse inspanning , zoals hardlopen, zware voorwerpen tillen, inspannend sporten	☐	☐	☐
b Matige inspanning , zoals het verplaatsen van een tafel, stofzuigen, fietsen	☐	☐	☐
c Tillen of boodschappen dragen	☐	☐	☐
d Een paar verdiepingen trappen oplopen	☐	☐	☐
e Eén verdieping opgaan	☐	☐	☐
f Vooroverbuigen, knielen of hurken	☐	☐	☐
g Meer dan een kilometer wandelen	☐	☐	☐
h Een paar honderd meter wandelen	☐	☐	☐
i Ongeveer honderd meter wandelen	☐	☐	☐
j Uzelf wassen of aankleden	☐	☐	☐

4. **Problemen ten gevolge van uw lichamelijke gezondheid DE AFGELOPEN 4 WEKEN**
(kruis één antwoord aan)

	Ja	Nee
a U besteedde minder tijd aan werk of andere bezigheden	☐	☐
b U heeft minder bereikt dan u zou willen	☐	☐
c U was beperkt in het soort werk of het soort bezigheden	☐	☐
d U had moeite om uw werk of andere bezigheden uit te voeren (het kostte u bijvoorbeeld extra inspanning)	☐	☐

5. **Problemen ten gevolge van emotionele problemen DE AFGELOPEN 4 WEKEN (zoals depressieve of angstige gevoelens)?** (kruis één antwoord aan)

	Ja	Nee
a U besteedde minder tijd aan werk of andere bezigheden	☐	☐
b U heeft minder bereikt dan u zou willen	☐	☐
c U heeft het werk of andere bezigheden niet zo zorgvuldig gedaan als u gewend bent	☐	☐

6. **In hoeverre hebben uw lichamelijke gezondheid of emotionele problemen u gedurende de afgelopen 4 weken gehinderd in uw normale sociale bezigheden met uw gezin, familie, vrienden of buren, of bij activiteiten in groepsverband?**
(kruis één antwoord aan)

- ☐ Helemaal niet
- ☐ Enigszins
- ☐ Nogal
- ☐ Veel
- ☐ Heel erg veel

7. Hoeveel lichamelijke pijn heeft u de afgelopen 4 weken gehad? (kruis één antwoord aan)

- ☐ Geen
- ☐ Heel licht
- ☐ Licht
- ☐ Nogal
- ☐ Ernstig
- ☐ Heel ernstig

8. In welke mate bent u belemmerd door pijn de afgelopen 4 weken bij uw normale werkzaamheden (zowel werk buitenshuis als huishoudelijk werk)? (kruis één antwoord aan)

- ☐ Helemaal niet
- ☐ Een klein beetje
- ☐ Nogal
- ☐ Veel
- ☐ Heel erg veel

9. Hoe vaak gedurende de afgelopen 4 weken (kruis één antwoord aan):

	Altijd	Meestal	Vaak	Soms	Zelden	Nooit
a Voelde u zich levenslustig?	☐	☐	☐	☐	☐	☐
b Was u erg zenuwachtig?	☐	☐	☐	☐	☐	☐
c Zat u zo erg in de put dat niets u kon opvrolijken?	☐	☐	☐	☐	☐	☐
d Voelde u zich rustig en ontspannen?	☐	☐	☐	☐	☐	☐
e Voelde u zich erg energiek?	☐	☐	☐	☐	☐	☐
f Voelde u zich somber en neerslachtig?	☐	☐	☐	☐	☐	☐
g Voelde u zich uitgeput?	☐	☐	☐	☐	☐	☐
h Voelde u zich gelukkig?	☐	☐	☐	☐	☐	☐
i Voelde u zich moe?	☐	☐	☐	☐	☐	☐

10. Hoe vaak hebben uw lichamelijke gezondheid of emotionele problemen u gedurende de afgelopen 4 weken belemmerd bij uw sociale activiteiten (zoals bezoek aan vrienden of naaste familieleden)? (kruis één antwoord aan)

Altijd ☐

Meestal ☐

Soms ☐

Zelden ☐

Nooit ☐

11. Wilt u het antwoord kiezen dat het beste weergeeft hoe juist of onjuist u elk van de volgende uitspraken voor uzelf vindt? (kruis één antwoord aan)

	Volkomen juist	Grotendeels juist	Weet ik niet	Grotendeels onjuist	Volkomen onjuist
a Ik lijk wat gemakkelijker ziek te worden dan andere mensen	☐	☐	☐	☐	☐
b Ik ben even gezond als andere mensen die ik ken	☐	☐	☐	☐	☐
c Ik verwacht dat mijn gezondheid achteruit zal gaan	☐	☐	☐	☐	☐
d Mijn gezondheid is uitstekend	☐	☐	☐	☐	☐