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Midterm Results of Quality of Life after Surgical Treatment of Tibial Plateau Fractures of Type Moore V

Reiner Wirbel

Abstract

The midterm restriction of the quality of life should be evaluated and correlated with the objective radiological results in patients with the special tibial plateau fracture of type Moore V. From 2003 to 2012, 36 patients with 38 fractures were registered in a retrospective cohort study. Injury mechanism, surgical treatment, complication rate, and radiological results after a mean follow-up of 37 months and the quality of life (NRS, IKDC-form, and EQ-5D-score) after 68 months were analyzed. There were 27 men and 9 women (mean age 50.8 years) in 30 cases with high impact injury. External fixator was used in 24 cases primarily, single plate fixation was used in 12 cases, and double plate fixation was used in 25 cases. All early complication (21%) could be cured. Mean NRS was 4.53, IKDC-score was 50.46, and the EQ-5D was 7.47. The quality of life was quoted to 44% of the output value before the injury. Osteoarthritis was seen in 36 cases; severe in 19 cases and 4 requiring endoprostheses. Loss of reduction and deviation of axis were seen in 13 and 3 patients, respectively. The tibial plateau of type Moore V is a severe injury resulting in the midterm reduction of the quality of life. There is a correlation of subjective and objective results.

Keywords: dislocation-fracture, tibial plateau, result, midtem, quality of life

1. Introduction

The incidence of proximal tibial fractures shows two age peaks: on the one hand, in young patients in the third decade of life with high energy, and on the other hand, in older patients in the sixth–eighth centuries; a decade of life mostly with low-energy trauma [1–5].

Many complications regarding soft tissues such as compartment syndromes, soft tissue damage, infections are possible; their frequency is given as 10–40% [6–8], in older papers even up to 80% [9]. The long-term course affects movement restrictions, axis misalignments with a frequency of 16–27% [6–8], developing post-traumatic arthritis with up to 60% when considering the complex fractures (Schatzker V and Schatzker VI) [8] or persistent Knee instability with a frequency of 11–18% [7]. Most proximal tibial fractures require surgical therapy with the intention of restoring the articular surface and the leg axis with the option of early active and passive movement therapy to avoid joint stiffness.

Although there are some studies on the functional result achieved and the development of osteoarthritis after tibial plateau fractures [1–5, 10–16], the comparability of many studies is limited since different fracture types are often summarized.

For example, studies on the ability of skiers to do sports report that about three quarters of all patients can do sports again after tibial plateau fractures, but the level before the accident is rarely reached [17, 18]. In a study by Kraus et al. [17], only 2 out of 11 professional skiers reach their starting level after 1 year.

In addition to purely functional and objective parameters, e.g., radiological results, aspects of quality of life after surgical fracture care have been increasingly taken into account in clinical studies over the past decade. As an expression of the subjective assessment of the quality of life, so-called patient reported outcome measures (PROMs) have been established through special questionnaires. Most of these PROMs have experience in the field of endoprosthetic joint replacement [19]. Even after fracture treatment, PROMs are becoming increasingly important [20]. There are only a few studies on the quality of life after the surgical treatment of tibial plateau fractures [7, 9, 21–23]. Mostly, different fracture types with different degrees of severity are considered together.

Tibial plateau fractures are difficult to classify with little reproducibility of all classification systems [24]. In principle, plateau fractures caused by axial trauma can be differentiated from the dislocation fractures due to additional shear and rotational forces [25]. Moore distinguishes five types in his classification [25]. The term “dislocation” does not describe a knee joint dislocation here, but rather a possible accompanying injury of ligaments should be pointed out, including the injury mechanism. Type V injury (“four part”) is a bicondylar fracture with a tear in the intercondylar region (**Figure 1**).

The clinical outcome after tibial plateau fractures is uncertain due to the primary damage to cartilage and subchondral bones, as well as metaphyseal compression.

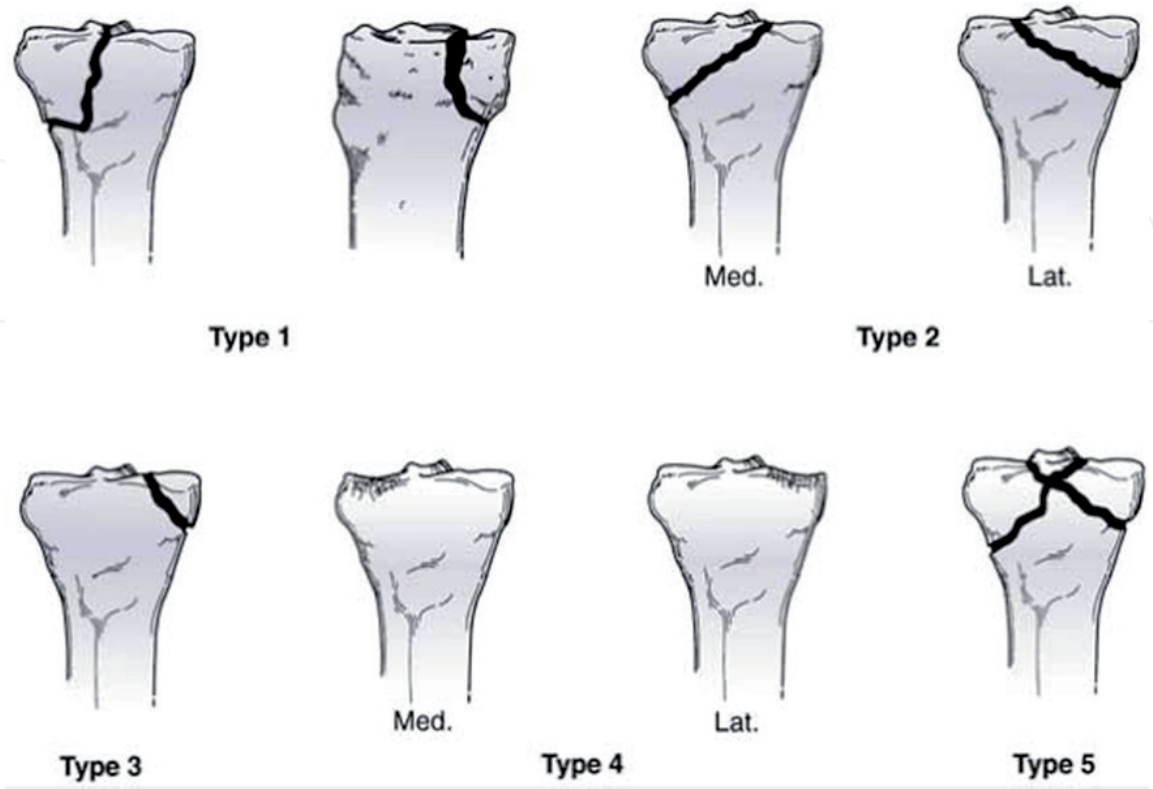


Figure 1.
Moore classification of tibial dislocation fractures.

An isolated consideration of the tibial plateau fractures of type Moore V, especially with regard to the expected quality of life, has not been available in the literature to date. For this reason, this rare special form of tibial head fracture was chosen as an expression of the most serious and complex destruction of the tibial head in the context of a multicenter survey in order to compare objectively functional clinical and radiological results with the subjectively estimated quality of life achieved.

2. Patients and methods

2.1 Patients

Patients with isolated Moore V tibial dislocation fractures on one or both sides were included. For classification, a CT examination was available preoperatively in all cases. Open fractures, fractures with accompanying vascular and/or nerve injuries as well as with accompanying fractures on the affected limb were not taken into account.

Three trauma surgery clinics took part in the multicenter retrospective cohort study, two clinics (I and II) with the mandate for maximum care and one clinic (III) as the main provider.

Over a period of 7 years (2005–2012), 193 tibial plateau fractures were treated surgically in clinic I, 25 of them were Moore V-type fractures, 20 of which were included in the study. In Clinic II, 137 tibial plateau fractures were treated surgically over a 9-year period (2003–2012). Of 10 Moore V fractures, 8 were included in the study. In Clinic III, 61 tibial head fractures were surgically stabilized over a 4-year period (2008–2012), 10 of 11 tibial head plateau fractures of the Moore V type could be checked again.

Two patients suffered bilateral fractures so that a total of 36 patients with 38 Moore V tibial plateau fractures were included in the study. The results of the patients with double-sided fractures were scored twice, each for the affected leg.

2.2 Objective parameters

In addition to the operative strategy (one-stage, two-stage care after primary fixator external treatment, and unilateral or bilateral plate osteosynthesis), the early complications within the first 2 postoperative weeks during the inpatient stay were evaluated. The last X-rays, performed on average after 37 months (range 12–102 months) after the surgery were used to determine the secondary loss of correction (misalignment, incongruency of the tibia plateau) and the development of arthritis according to Kellgren/Lawrence [26]. The measure of the axis misalignment was determined in the whole leg.

2.3 Subjective parameters

A questionnaire after an average of 68 months (range 16–128 months) collected subjective data to assess pain, function, and quality of life, in addition to the numerical analog scale (numeric rating scale—NRS) [8, 27] for pain indication, the IKDC score (international knee documentation committee) [28], and the defined quality of life according to EQ-5D (European quality of life—5 dimensions) [29, 30].

Current pain and pain over the past 4 weeks were recorded using NRS (0–10). A total of 5 pain groups were defined: no pain: NRS = 0; mild pain: NRS = 1–3; moderate pain: NRS = 4–6; severe pain: NRS = 7–8, and very severe to severe pain: NRS = 9–10.

In addition, the ratings were collected for nightly and also divided into five groups: I: never; II: occasionally; III: every other night; IV: more often than every other night; V: every night.

The IKDC score compares the affected knee with the opposite side with regard to sporting and everyday activity, the result is given in percent (opposite side = 100%). The EQ-5D (EuroQol) questionnaire describes the five dimensions of the state of health: mobility, self-sufficiency, everyday activity, pain, and fear/depression, each with a value of 1–3. This results in total values between 5 and 15, where a low value corresponds to a high quality of life.

In addition, the numerical analogue scale (0–10) [27] was used to record the subjective assessment of the functionality of the affected knee joint, 0 being the inability to perform any normal everyday activity, possibly including sports, and 10 being the normal, excellent functionality.

2.4 Statistics

The statistical evaluation of the individual groups was carried out using the Wilcoxon rank test, and the t test for independent samples. The statistics program SPSS version 2.0 (SPSS Inc., Chicago, USA) was used for this. A p-value <0.05 was determined to be significant.

All patients were informed and gave their consent to the publication of their data.

3. Results

3.1 Patients and surgical procedures

The average age of the 36 patients was 50.8 years (range 24–74 years), that of the 27 men was 49.3 and that of the 9 women was 52 years. There were high-energy traumas in 30 cases, mostly traffic accidents and sports injuries, and only 6 cases of low-energy traumas (falls at home).

About 24 of 38 fractures were stabilized primarily on the day of the accident by external fixator. In one of these cases, the fracture healed with subsequent arthrodesis. In 12 patients, a singular, locking plate fixation was performed from lateral (4x primary, 8x secondary); in 25 patients, two plates (lateral, locking plate, dorso-medial anti-slide plate) (**Figure 2**) were applied (10x primary, 15x secondary). The anterior cruciate ligament was refixed 3 times in total; bone replacement materials (bovine cancellous bone) were only used in 4 cases.

On the day of the accident, only 4 cases were primarily openly reduced and stabilized; all other of 14 fractures were immobilized with a splint and, as in the case of secondary care after external fixation, were openly reduced and stabilized on the 4th day (range 3–7th day) on average.

3.2 Complications

In 8 patients, there were early complications within 14 days postoperatively during the inpatient stay: local infections was seen in 2 patients, implant loosening with secondary dislocation of the fracture in 4 patients, compartment syndrome in 1 patient, and infection + compartment syndrome in 1 patient. All complications could be remedied by surgical measures (debridement, vacuum sealing, refixation, and opening of the compartment). Single plate fixation was performed in seven of these complications; however, statistical significance analysis is not possible due to the small number of cases.

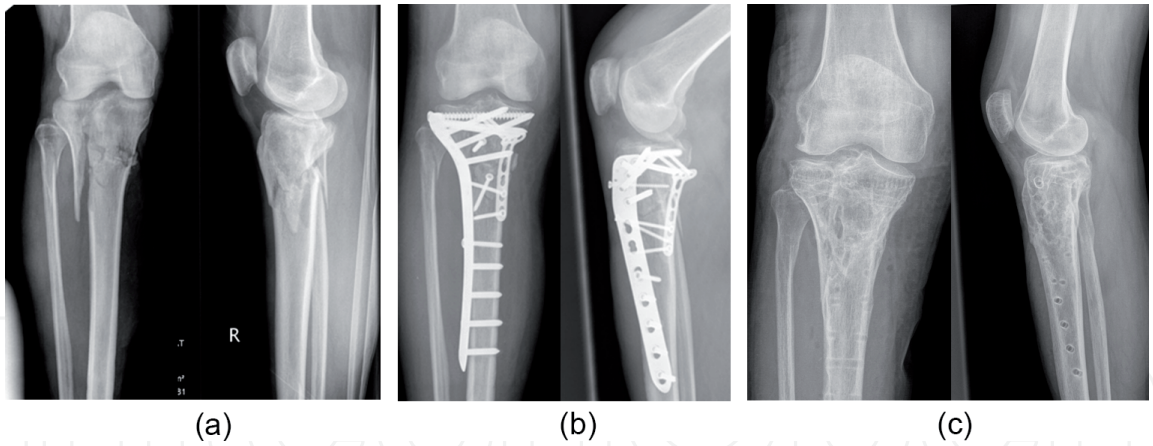


Figure 2.
A 58-year-old patient after falling from a chair; (a) X-ray image AP and sideways on the day of the accident; (b) postoperative; (c) 21 months later after implant removal (after 62 months: degree of osteoarthritis according to Kellgren/Lawrence 1; indication of pain NRS 0; IKDC 81.6; EQ-5D: 5).

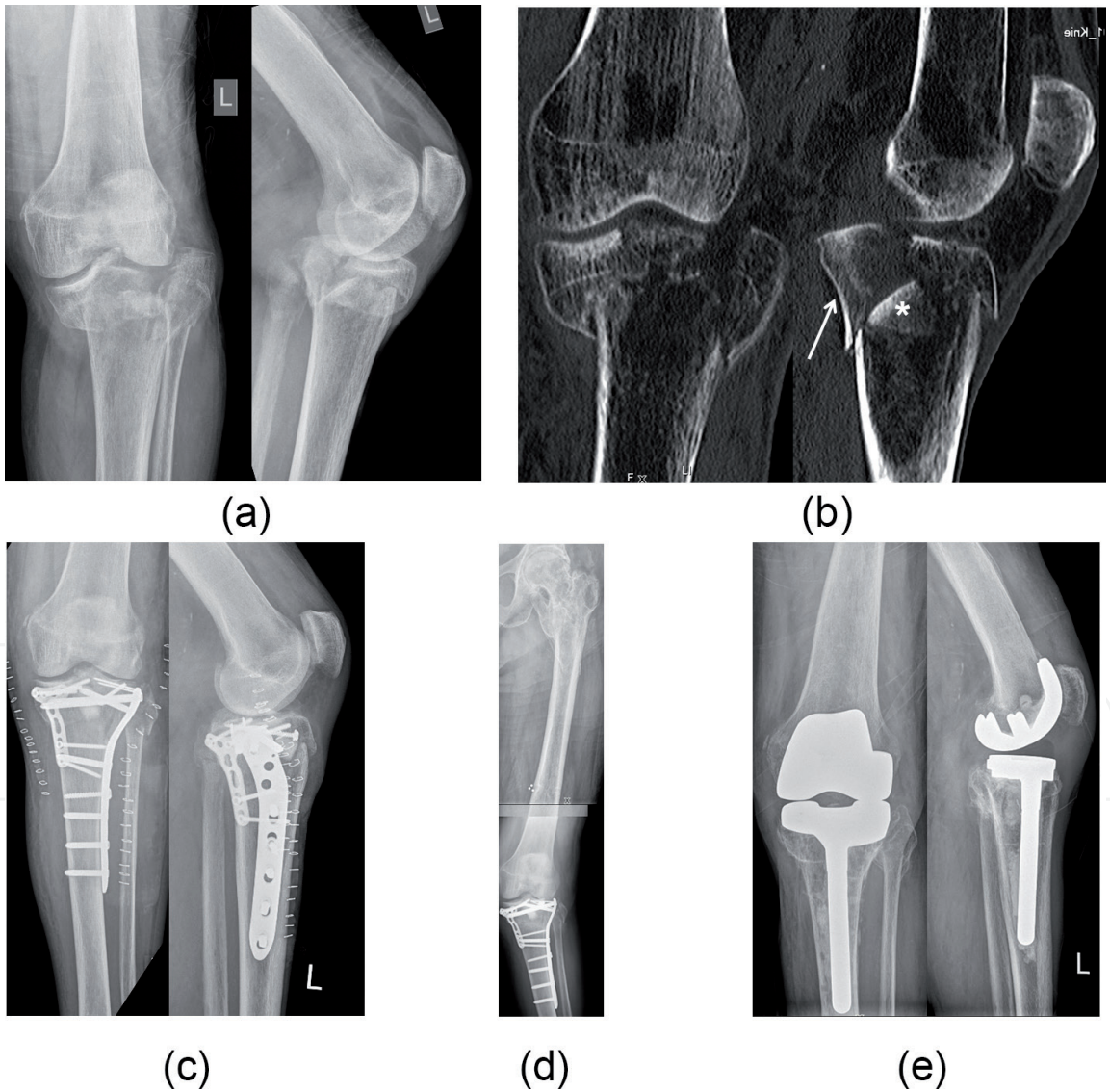


Figure 3.
A 74-year-old patient after falling down stairs at home: (a) X-ray image AP and sideways on the day of the accident; (b) CT with coronary and sagittal incision: dorsomedial fragment (arrow), central impressed fragment (star); (c) early elective care with double plate osteosynthesis on day 3, sub-central feeding with ceramic bone substitute material; (d) CT 4 months postoperatively with evidence of lateral correction loss >2 mm and valgus position (10°); (e) early elective bicondylar surface endoprosthesis replacement due to pain and inability to walk (long tibia shaft, lateral wedge) 5 months after primary care (after 20 months: pain indication NRS 3; IKDC 52.9; EQ-5D: 6).

Kellgreen/Lawrence score [*]	I	II	III	IV
n	1	13	16	3
Ø NRS pain [0–10]	0	4.38	5.4	6.3
Loss of correction ^{**}	bis < 2 mm		≥2 mm	
n	24		13	
Ø NRS pain [0–10]	3.88		5.42 [p = 0.04]	
Ø pain at night [1–5]	1.88		3 [p = 0.03]	
[*] n = 33—4 patients with secondary endoprosthesis and 1 patient with arthrodesis were not evaluated.				
^{**} n = 37—the patient with arthrodesis was excluded.				

Table 1.
Relationship between pain and degree of arthritis and loss of correction in patients with tibial plateau fractures of the type Moore V.

3.3 Objective results

Since a patient was treated in the external fixator with subsequent arthrodesis, a fracture loss in the 37 of the 38 fractures could be recorded in the average 37 months postoperative X-rays: 1 mm in 10 cases, 2 mm in 7 cases, and >2 mm in 6 cases. In 2 patients, there was a valgus deformity (in 1 patient 10° and in 1 patient >20°), and in 1 patient, a varus deformity (10°). A secondary correction loss of ≥2 mm (**Figure 3d**) was shown in 8 patients in the group of bilateral plate fixation (43%) and in 5 patients in the group of single plate fixation (57%). In view of the small number of cases, a significant statistical difference cannot be obtained here either. Endoprosthetic joint replacement was performed in 4 patients after an average of 6 months (range 5–8 months). Except for one case with a necessary proximal tibia replacement over 6 cm, bicondylar surface replacement endoprotheses were used (**Figure 3e**).

One patient was healed in the external fixator with primary arthrodesis. In 5 of the remaining 33 patients, an implant removal was removed after an average of 19.8 months (range 3–54 months).

Radiologically, all 33 remaining fractures showed signs of arthritis after an average of 37 months. According to Kellgren and Laurence, the degrees of severity were distributed as follows: grade I: n = 1 (**Figure 2**); grade 2: n = 13; grade 3: n = 16; and grade 4: n = 3 (**Table 1**).

At the time of the survey, 4 patients (10.5%) had partial disability assessment or a corresponding application due to the knee injury.

4. Subjective results

4.1 Pain and swelling

Within the last 4 weeks before the survey, only 2 patients stated that they had no pain. The division of pain sensation into 5 groups and the nocturnal pain indication are shown in **Figure 4**. On average, the NRS (0–10) for the pain in the last 4 weeks was 5.25 and for the night pain (1–5) was 2.27.

There was no influence from the primary surgical procedure (one, two, unilateral, and bilateral plate fixation). The mean pain reported during the past 4 weeks was higher in patients with a correction loss ≥2 mm (NRS 5.42) than in patients without loss of correction (NRS 3.88). The difference was statistically significant

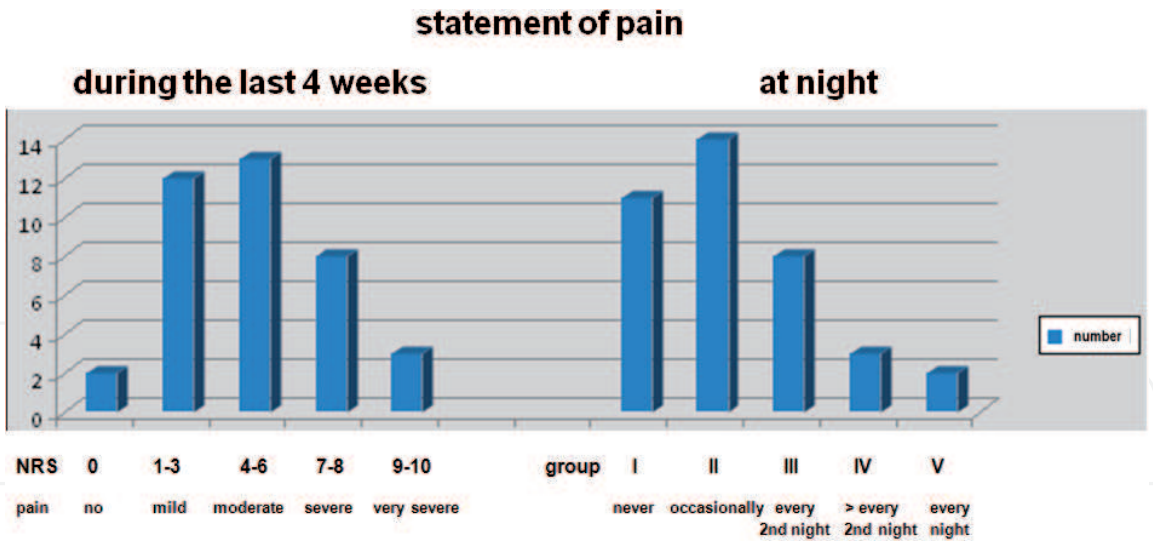


Figure 4.
Pain sensation in 36 patients with 38 tibial plateau fractures of the type Moore V (2 patients with bilateral fractures scored twice, each for the affected knee).

($p = 0.04$). With regard to the nocturnal pain indication, this difference (NRS 3 versus 1.88) was also significant ($p = 0.03$).

With regard to the assessment of the tendency to swell during the last 4 weeks before the survey in 5 degrees of severity, similar distributions resulted as with the pain indication: “not at all” was reported by 5 patients, “somewhat” by 21 patients, “fairly” by 8 patients, “very” by 3 patients, and “extremely” was reported by 1 patient.

4.2 Sports and everyday activity

Similar results were found in the survey on sporting and everyday activities. Only 1 patient reaches the highest activity level (soccer); moderate activity (running) was possible in 6 patients; light activity (walking) was possible in 25 patients; and no sporting activity was possible in 6 patients.

Very strenuous everyday activities were only given in one case, strenuous in 4, moderately strenuous in 7, light activities in 27, and no activities in 3 cases.

4.3 IKDC and ED-5Q scores

The mean for the IKDC score was 50.46 (range 25.3–93.1). There were no significant differences regarding the operative strategy (one, two, unilateral, and bilateral plate fixation), gender or the fact of a secondary loss of correction. In the group of patients who had complications, the value was reduced compared to the group without complications (42 versus 52), but the difference was not significant. The 4 patients who received or applied for an invalidity pension showed a significantly poorer IKDC score compared to the group without any relief (41.25 versus 51.56, $p = 0.01$).

The mean of the EQ-5D score was 7.47 (range 5–10; standard deviation 1.5). The results were better in female patients when there was no complication or secondary correction loss; however, the differences were not all significant. When retiring or applying for a pension, the EQ-5D score was 8.5 and without retirement it was 7.35 ($p = 0.016$).

	Median (ø)	Range	Standard deviation
NRS pain [*] [0–10]	5.25	0–10	±2.5
Pain at night ^{**} [1–5]	2.27	1–5	±1.6
IKDC [0–100]	50.46	25.3–93.1	±17.57
EQ-5D [5–15]	7.47	5–10	±1.5
NRS functionality [0–10]	4.53	0–9	±2.61

^{*}Pain reported during the last 4 weeks before the questioning after ø 68 months.

^{**}Classification of pain at night: 1—never; 2—occasionally; 3—every 2nd night; 4—>every 2nd night; 5—every night.

Table 2.
Parameters to determine the quality of life in 36 patients with 38 tibial plateau fractures of the type Moore V.

4.4 Functionality

According to the NRS, the mean value for the affected knee before the injury was 9.68 (range 6–10, standard deviation 0.904) and at the time of the survey was 4.53 (range 0–7, standard deviation 2.617). The difference was significant ($p < 0.001$). The NRS was significantly ($p = 0.019$) lower in patients with complications (2.63) compared to those without complications (5.03). There was also a tendency toward lower values in patients with a correction loss ≥ 2 mm and patients who received a disability pension or applied for it, but these differences were not significant. The information on the subjective indication of pain, the IKDC score, the ED-5D score, and the functionality of the affected knee joint are listed in **Table 2**. There were no other differences with regard to the surgical procedure or the surgical strategy.

5. Relationship between objective and subjective results

The degree of arthritis correlated with the pain information (**Table 1**). Only 1 patient showed a Kellgren/Lawrence grade 1 (**Figure 2**) with a pain indication of NRS = 0. An arthritis of grade 2 correlated with an average NRS of 4.38 (range 3–8), an arthritis of grade 3 with an NRS of 5.4 (range 2–10), and an arthritis of grade 4 with an NRS of 6.3 (range 5–8); there was no statistical significance.

When all parameters were considered, the quality of life after tibial plateau fractures of the type Moore V was reduced to 44% of their initial value.

6. Discussion

Tibial plateau fractures are rare and they make up about 1–2% of all bone injuries [1–5]. Approximately 80–85% are plateau fractures and approximately 15–20% are “dislocation fractures” [25]. The most serious form of dislocation fracture, the type V fracture according to Moore, is still considered difficult to treat with an unfavorable prognosis. Depending on the soft tissue situation, the two-stage procedure is preferred for the operative care. After primary immobilization in the joint fixator, the treatment algorithm includes external and necessary CT diagnostics for precise fracture analysis, the definitive osteosynthesis after 5–6 days; angle-stable mono- or bicondylar plate osteosynthesis are usually performed [1–5, 7, 10–16, 21–23, 31]. The dorsomedial fragment, which has a certain key function

due to the generally intact side band, is to be stabilized with an anti-slide plate [1–3, 10, 12, 14, 16, 31].

It was striking in our own case series that bone replacement materials were only used in 4 cases (10.5%). In the literature, this requirement is stated to be around 30% [1–5]. This discrepancy can be caused by the selected fracture type (Moore V); the defect zone is usually filled in with plateau fractures of the impression type.

Clinical-functional and radiological results after tibial plateau fractures have been described several times, but mostly different types of fractures are summarized. The follow-up rate is often only 50–60% [14, 31]. In our study, all patients could be asked about their quality of life with a targeted questionnaire. The follow-up period of 5.6 years is in the average range compared to the literature.

The average age in our study is 50.8 years lower than in most other studies. The reason for this may be that tibial head dislocation fractures of the Moore V type were considered separately. This usually requires high-energy trauma, in the study presented in 30 out of 36 patients, to whom younger patients are increasingly exposed. However, even older patients may experience a tibial plateau fracture of type Moore V due to their possible reduced bone quality in the context of low-energy trauma. This does not change the operational care strategy of the two-stage approach given above.

The complication rates after surgical treatment when considering all tibial plateau fractures fluctuate between 2 and 40% [6, 9], when isolating type C fractures according to the AO classification up to 40% complications are reported [10, 12, 14, 16, 21, 31]. Local infections and implant loosening are summarized. In the study presented, this value was 21.1%. In an older study, infection rates of 32% for unilateral plate fixation and even 82% for bilateral plate fixation are given [9]. However, this information can only be used to a limited extent, and 47 tibia head fractures were taken into account. Double plate fixation was only used in 8 out of 24 type C fractures, with local infection or wound healing impairment occurring in 7 cases. By recognizing the importance of soft tissue protection, this high infection rate could also be reduced by developing minimally invasive approaches, especially on the medial tibia head [6]. Extended medial approaches have also been described to address this important medio-dorsal fragment [32].

The discrepancy in the number of uni- (in 12 cases) and bilateral plate fixation (in 25 cases) in the study presented for the same fracture type could be explained by the fact that different surgeons at different clinics were at risk despite the knowledge of a better radiological outcome due to the local soft tissue situation of an infection had foregone an additional medial plate system.

Various authors generally describe a higher secondary correction loss of up to 15% after lateral plate fixation alone [16, 31]. This could not be confirmed in our own case series; however, the number of cases was too small to make a statistical statement here.

The frequency of secondary axis misalignments is different in the literature, mostly given as 10–30% [1–5, 16, 22, 31]. In our own approach, 3 axis deviations (7.8%) were seen, whereby only misalignments of $>10^\circ$ were taken into account. The consideration of an axis deviation “only” from 10° can be cited as a weakness of the study. Smaller deviations have also been measured in various studies [6–8]. The limitation described was justified because clinical relevance with the possible indication for correction often only arises from a deviation of $>10^\circ$. However, this cannot rule out that even minor axis deviations can have consequences for the functional outcome.

There is no precise information in the literature about the incidence of necessary secondary endoprosthetic replacement. In the presented study, 4 endoprotheses (10.5%) were necessary in the course. Primary endoprosthetic replacement has not been of any importance, at least to date, for the form of fracture presented. The quality of reduction, i.e., continuous restoration of the articular surface and alignment of the axis correlates with the clinical outcome in most, both older [33–35] and younger [1–5, 8, 10–16, 36] publications. In the work by Marsh et al. [37], however, there are no reliable indications that a continuous restoration of the joint surface really affects the overall clinical result.

A big problem of many of these studies is again listed here that different fracture types are combined.

The success of therapy must be assessed more than ever by the patient himself. In addition, the patient reported outcome measures (PROMs) already established in endoprosthetic replacements are becoming increasingly important in fracture care [17, 18].

Studies about the quality of life of tibial plateau fractures are rare. For example, Rossbach et al. [7] reported in a recently published study on the quality of life and work ability of 41 patients with surgically treated tibial plateau fractures. A total of 18 fractures were classified as C fractures according to the AO classification, 11 as dislocation fractures according to the Moore classification, of which only 2 were type V fractures. Since there were also many multiple injuries, it could not be determined exactly whether the restriction of the SF-36 score was solely due to the tibial fracture. Overall, however, there was also a significant correlation between the radiological result and the quality of life achieved. This could also be confirmed in our case series with a correlation between pain information and degree of activity of the arthritis or secondary loss of correction (**Table 2**). The correlation was even significant with regard to the last parameter. However, given the small number of cases, this correlation is only favored as a trend.

Overall, the data of the subjective pain assessment in the own case series are worse than in the comparative literature [7, 11, 21–23]. Only 5% of our patients said they had no pain and 25% experienced severe to very severe pain. Two phenomena can be responsible for this. On the one hand, only the severe form of the type Moore—V fracture is considered in the presented study; most of the other studies also include other forms of fracture. On the other hand, the patient age is lower. Younger patients tend to idealize their state of health before the injury and are generally more demanding than older patients, with poorer results.

Similar results can be seen for the assessment of the function of the affected knee joint and the activity level of the patients, recorded using the IKDC score. The results correlate with the information provided by Jansen et al. [10], which examined 22 patients with 23 type C fractures (AO classification) with an average follow-up of 67 months. Only 3 patients (13.6%) had a good to very good result in the IKDC score, and 14 patients (60%) had a low activity level. The follow-up period is almost identical to that of your own case series.

The assessment of sporting activity as a measure of the level of activity achieved and the quality of life shows similar results. Only 1 of the 36 patients (2.7%) achieved the highest level of activity (football); only slight activity (walking) was possible in 25 patients (69.4%) and no activity was possible in 6 patients (16.6%). This can also clarify the severity of the injury. In the literature, a return to sporting activity is reported at a lower level in about 75% of patients when all tibial plateau fractures are considered. However, high-performance athletes rarely reach their starting level despite intensive training [17]. In a study by Loibl et al. 62% of recreational athletes with intra-articular tibial plateau fractures rated their sporting activity level after 7 years on average as similar as before the

accident, while 38% rated this as significantly worse [18]. The worse values in our patient series can be explained by the isolated consideration of the Moore V fractures.

With regard to the development of arthritis, there were differences in the patient's own case series compared to the information provided by Jansen et al. [10]. Missing signs of arthritis were only found in 3% of our own study. Jansen et al. saw in 30% and severe signs of osteoarthritis in 59% and 26%. The discrepancy could again be due to the fact that the heavy form of the Moore V fracture was considered in isolation.

Altogether, the tibial plateau fracture of type Moore V represents a serious injury; the patient's quality of life is considered to be 44% of their original value after an average of 5 years after considering all parameters. The subjective information on quality of life correlates with the objective radiological parameters (degree of arthritis and loss of correction).

In a recently published clinical study [38], a reduction in the quality of life to 75 was observed in 71 patients with tibial plateau fractures after 1 year. However, all fracture types were taken into account; a connection between radiological osteoarthritis development and functional outcome could not be demonstrated.

A significant limitation of the presented study could be seen in the fact that the subjective information was collected after an average of 68 months, whereas the objective radiological criteria were obtained after an average of 37 months. The information in the study by Rademakers et al. [2] confirm, however, that if 109 tibial plateau fractures are considered over a follow-up period of up to 27 years, a significant improvement in knee joint function can no longer be expected after more than a year. Since there was no current radiological diagnosis at the time of the examination, even stronger and more frequent signs of arthritis may have been added in the meantime.

It can also be critically noted that the secondary loss of correction was measured using a native X-ray examination. A CT examination would have given more precise data with a possibly higher incidence of joint levels or mismatches of the articular surfaces.

Therefore, as with the further point of criticism of the small number of cases, the information on the relationship between quality of life and radiological result can only be interpreted or understood as tendencies.

Tibial plateau fractures of the type Moore V are severe injuries of the knee joint with a clearly limited quality of life in the medium term, whereby their subjective assessments correlate with the objective radiological parameters.

Therefore, the surgical treatment of tibial plateau fractures must be as precise as possible, i.e., to strive for step-free reconstruction of the articular surface and the tibial shaft axis.

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