



Early functional rehabilitation after patellar dislocation—What procedures are daily routine in orthopedic surgery?



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ABSTRACT

Introduction: Patellar dislocation and rupture of the medial patellofemoral ligament (MPFL) are frequently seen in daily orthopedic practice. Besides initial non-surgical treatment, surgery and subsequent rehabilitation are crucial for restoring stability in the femoropatellar joint. This study investigated current rehabilitation strategies after patellar dislocation because knowledge on this topic has been severely limited so far.

Materials and methods: The current rehabilitation protocols of 42 orthopedic and trauma surgical institutions were analyzed regarding their recommendations on weight bearing, range of motion (ROM), and use of movement devices and orthosis. All protocols for conservative treatment and postoperative rehabilitation after MPFL reconstruction were compared. Descriptive and statistical analyses were carried out when appropriate.

Results: The different rehabilitation strategies for conservative and surgical treatment after patellar dislocation showed a tendency towards earlier functional rehabilitation after surgical MPFL reconstruction than after conservative treatment. Both surgical and conservative treatment involved initial restrictions in weight bearing, ROM, and use of movement devices and orthosis at the beginning of rehabilitation. The rehab protocols showed a significant earlier full weight bearing after surgical MPFL reconstruction ($p > 0.001$). Due to the presence of other parameters for early functional treatment, the absence of an indication for using orthosis (surgical: 44%, conservative: 33%; $p = 0.515$) or start of unlimited ROM of the knee (surgical: 4.9 weeks, conservative: 5.7 weeks; $p = 0.076$) showed by trend an earlier functional strategy after MPFL reconstruction than after conservative therapy.

Conclusions: Both conservative and surgical treatment after patellar dislocation showed restrictions in the early phase of the rehabilitation. Earlier functional therapy was more common after MPFL reconstruction than after conservative treatment. Further clinical and biomechanical studies on rehabilitation strategies after patellar dislocation are needed to improve patient care und individualized therapy.

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Introduction

Patellar dislocation and subsequent deficiency in or rupture of the medial patellofemoral ligament (MPFL) is a common knee injury [1]. Patellar dislocation usually occurs at the lateral side, leading to rupture of the MPFL in about 90% of patients [2]. Biomechanical as well as anatomical studies have marked the MPFL as the main stabilizer of the patella in the patellofemoral joint between 30°

flexion and full extension [3]. Although patella dislocation occurs only in 23% of all knee injuries [4], the consequences are highly important in daily routine because femoropatellar joint dislocation has a recurrence rate of nearly 40% [5]. The literature does not show any significant difference in outcome between surgical and non-surgical treatment after the first patellar dislocation [6]. On the other hand, patients with recurrent patellar dislocation have a risk of re-dislocation of nearly 50% [7]. Surgery is therefore strongly recommended after the second dislocation [8]. Knee kinematics and kinetics usually return to normal during gait only 1 year after surgery [9]. Particularly athletes requiring an early return to sports, but also less active people may want to stabilize and strengthen their lower limbs to prevent re-injury [10]. MPFL insufficiency with

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subsequent patellar instability compromises the function of the patellofemoral joint and may lead to early osteoarthritis [11]. Additionally, the literature shows highly variable techniques for MPFL reconstruction [12].

Several national and international guidelines exist for both non-surgical and surgical treatment [13,14]; however, these guidelines are less based on scientific evidence but mainly represent expert recommendations. Therefore, different institutions provide their patients with different rehabilitation protocols. These individual protocols may differ from officially published guidelines both in surgical and conservative treatment. Overall, rehabilitation after patellar dislocation or MPFL reconstruction has been hardly investigated and is thus hardly represented in the scientific literature [15,16]. In contrast to, for instance, injuries to the Achilles tendon, no evidence is available on the indication for early functional rehabilitation after patellar dislocation, and information about current concepts is rather limited [17].

The purpose of this study was to show the difference between individual treatment protocols for surgical and conservative treatment after patellar dislocation. Additionally, we investigated to what extent an early functional strategy is included in current rehabilitation strategies for conservative and surgical treatment after patellar dislocation.

Materials and methods

The rehabilitation protocols of 123 orthopedic and trauma surgical institutions in Germany, Austria, and Switzerland conducting knee surgery in general were descriptively analyzed. 39 protocols providing information on patellar dislocation and MPFL rupture were reviewed both for surgical and non-surgical treatment. Data were collected retrospectively using the standardized rehabilitation protocols of the different institutions.

The concepts for weight bearing, ROM, and use of orthosis as well as active or passive movement devices were compared. Because of the different grades for weight bearing stated in treatment instructions, the grades were classified into four steps that applied to all protocols of every institution: no weight bearing, partial weight bearing, half body weight, and full body weight (see Table 1). Recommendations from the first day after surgery until the fourth month after surgery were included.

The rehabilitation protocols also differed with regard to ROM significantly. For a better overview and because of the lack of clinical relevance, a standardized neutral zero method was used and 5 stages summarized all recommended individual protocol information in this study, beginning with complete immobilization, with 0-0-30°, 0-0-60°, 0-0-90° and free ROM (see Table 2). Data were collected for the first 12 weeks after surgery

The last week after surgery was used for evaluating the overall length of orthosis use. Besides the absolute length of time, the initial time point of using orthosis was examined. The prescription of an active or passive movement device by an institution was also investigated. The investigated period was determined from the first day until the fourth month after surgery.

Overall, considering the hypothesis of this study, early functional treatment was compared to more restricted treatment. Early functional treatment was defined by several parameters and measured at the earliest time point of the therapeutic concept (see Table 3).

Table 1
Grading of weight bearing in rehabilitation protocols.

No weight bearing	Partial weight bearing	Half body weight	Full body weight
0 kg	≤20 kg	>20kg	no restriction

Table 2
Compendium of ROM after neutral zero method in rehabilitation protocols.

Immobilization	0-0-30°	0-0-60°	0-0-90°	Free
0-0-0	0-0-20	0-0-50	0-0-80	0-0-120
0-0-10	0-20-20	0-10-0	0-10-80	
	0-10-30	0-10-60	0-10-90	
	0-0-40	0-0-70	0-0-100	
	0-10-40	0-10-70	0-10-100	

Table 3
Definition of early functional therapy after patellar dislocation.

Treatment parameters	Maximum early functional parameters
Range of motion	Unlimited
Weight bearing	Full
Orthosis	No use of orthosis
Movement device	Start

Statistical analysis was done with SPSS® (Version 23, IBM, Armonk, NY, USA). Where appropriate, data were analyzed for mean and/or highest percentage. Graphical illustrations were generated with GraphPad Prism® (Version 5.01, GraphPad Software, La Jolla, CA, USA) and Microsoft Powerpoint 2013® (Microsoft Corporation, Redmond, WA, USA). A probability (p) value of 0.05 was considered significant for the test and marked in the text and tables with “*”. In addition, the t-test was used.

Results

39 standardized protocols were available for the treatment of patellar dislocation, 27 for rehabilitation after surgical MPFL reconstruction and 12 for conservative treatment. However, the protocols provided for tibial tubercle osteotomy were excluded from data assessment because of the low number of 3 protocols only (see Fig. 1).

Overall, rehabilitation after MPFL reconstruction showed an earlier start of functional treatment strategies than rehabilitation protocols for conservative treatment. Full weight bearing was possible after a mean of 2.1 (SD 1.6) weeks after surgery and after 5.2 (SD 1.9) weeks of conservative therapy (p < 0.001). Over 70% of

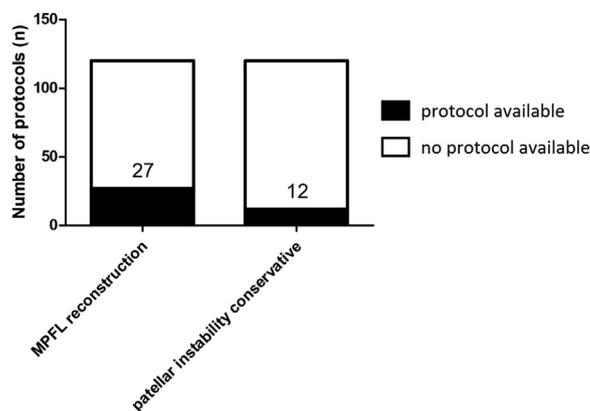


Fig. 1. Surgical and non-surgical treatment after patellar dislocation.

the protocols after MPFL reconstruction recommended full weight bearing within week 3, and all protocols recommended full weight bearing after week 6. The conservative treatment strategy showed a more restrictive approach: 50% of protocols did not allow full weight bearing before week 5 and complete weight bearing not before week 9 (see Fig. 2).

The rehabilitation protocols varied widely with regard to ROM after patellar dislocation. Complete immobilization was rare, and full ROM was mainly started after week 5–6 in both treatment strategies (surgical: 4.9 (SD 1.7) weeks, conservative: 5.7 (SD 0.7) weeks; $p=0.076$; see Fig. 3).

44.4% of the rehabilitation protocols after surgery recommended an early functional concept without orthosis. If higher protection with use of an orthosis was recommended, the device was worn for an average of 6.3 ± 1.8 weeks. 33.3% of conservative treatment protocols did not recommend use of orthosis ($p=0.515$). If orthosis was recommended, the recommended time of use was 5.75 ± 0.66 weeks ($p=0.419$). The length of use recommended by 87.5% of the protocols for both surgical and conservative treatment was 6 weeks (see Figs. 4 and 5).

40% of the protocols for surgical treatment recommended the use of an active movement device (CAM) after a resting phase of 1–2 weeks. The period of use was mainly 6 weeks, in some protocols up to 10 weeks. Because a period of resting is inapplicable during conservative therapy, over 90% of these protocols recommended use of a CAM from the very start of rehabilitation for 6 weeks (see Fig. 6). On the other hand, use of a passive movement device (CPM) plays a very minor part in surgical therapy and is rather immaterial for the conservative concept.

Discussion

The most important finding of this study is the current restricted application of the early rehabilitation phase in both surgical and conservative treatment after patellar dislocation. Protocols for conservative treatment were more restrictive with regard to weight bearing and by trend in ROM and use of orthosis in the first weeks after trauma, whereas after surgery it was conducted in earlier functional settings. This study is the first to publish information about current rehabilitation protocols after patellar dislocation. According to the literature, early functional therapy is required after ligamentous or tendinous injuries [17]. Nevertheless, there is no consensus on the proper definition of functional therapy [13,18]. This study therefore defined the start of early functional therapy with the advanced or maximum possible

removal of weight bearing restrictions, missing use of orthosis, or unlimited range of motion. The literature includes several different recommendations regarding rehabilitation protocols for surgical and conservative treatment after patellar dislocation [18,19], but early rehabilitation after patellar dislocation is still underrepresented and lacks sufficient scientific evidence. Despite the intensive research on MPFL reconstruction and other treatment options [20,21], no overall accepted protocol exists for the early phase of rehabilitation or a safe return to sports, which is the primary concern of every athlete [22].

The rehabilitation protocols after surgical treatment varied widely regarding weight bearing and ROM [7,22]. This wide variation is a crucial reason for the lack of standardized guidelines for optimizing rehabilitation and minimizing time loss after injuries. Full weight bearing was not restricted at all in some studies, in other studies full weight bearing was not allowed before week 7 [18]. Similar differences were found with regard to ROM: the examined literature varied from free ROM after 4 weeks to ROM restricted to 45–60° of flexion after week 5 [20]. Zaman et al. [22] found recommendations for use of orthosis in more than 75% of protocols in contrast to 55% in our study. The importance of postoperative immobilization or rather the use of orthosis after patellar dislocation is still inadequately investigated.

Postoperative therapy with a CAM or CPM movement device is not well described in the literature. The beginning of therapy with a movement device is set between day 2 and 3 after surgery [7]. This time point was also found for about 60% of the investigated protocols with a CAM in our study. On the other hand, the high variability of protocols is also shown with regard to CAM or CPM therapy: some protocols recommend start of this therapy not before week 3 after surgery. Furthermore, use of a CPM was hardly represented in that survey and only observed after surgical therapy.

Conservative treatment is generally indicated after primary patellar dislocation without flake fracture [23,24]. With regard to conservative care after dislocation of the patellofemoral joint, literature reports agree on immobilization for 2–3 weeks using an orthosis with a limited flexion from 15° to 30° as soon as the pain is tolerable [25]. In case of advanced mobilization, opinions in the literature are divided. Some studies advise against early mobilization because of higher rates of re-dislocation [26], whereas other authors recommend early mobilization with pain-adapted weight bearing. However, no specific time tables are provided [25,27]. Another argument for early weight bearing is preserving adequate trophic balance of the joint cartilage [28]. After the initial phase of

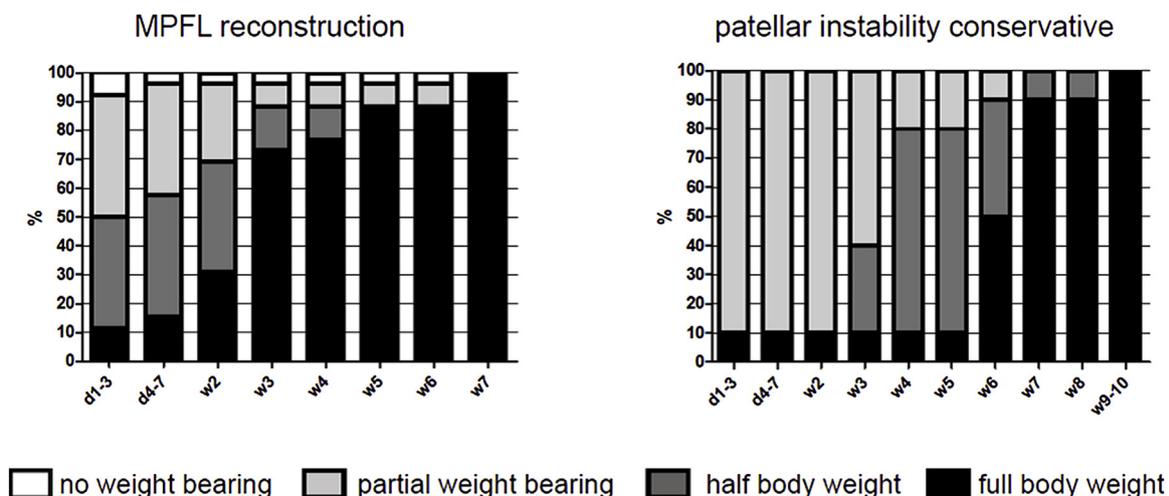


Fig. 2. Differences in weight bearing for surgical and non-surgical treatment after patellar dislocation.

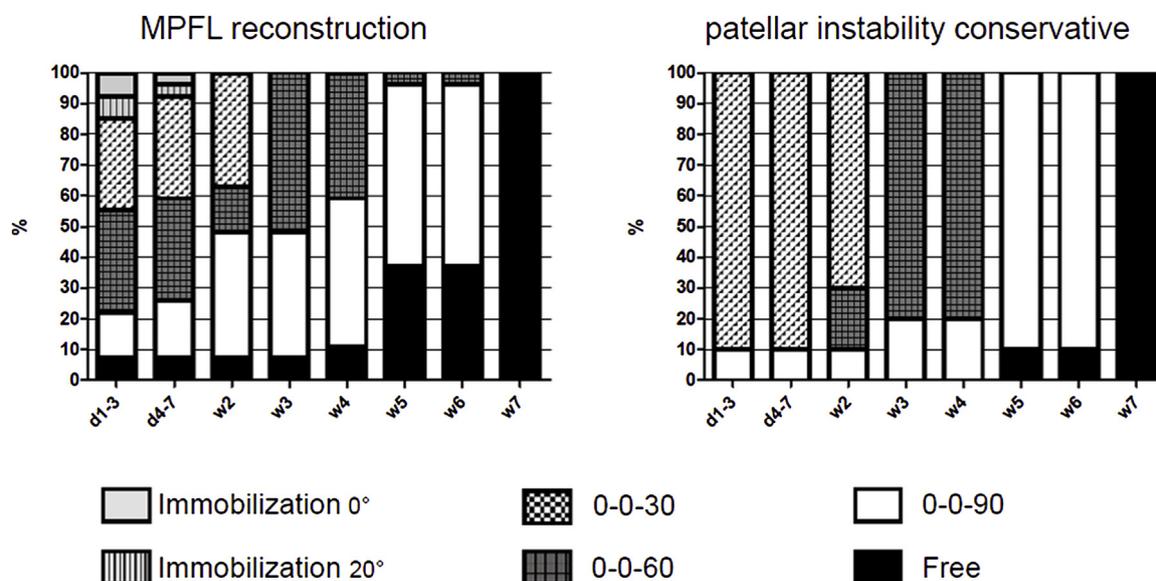


Fig. 3. Differences in ROM for surgical and non-surgical treatment after patellar dislocation.

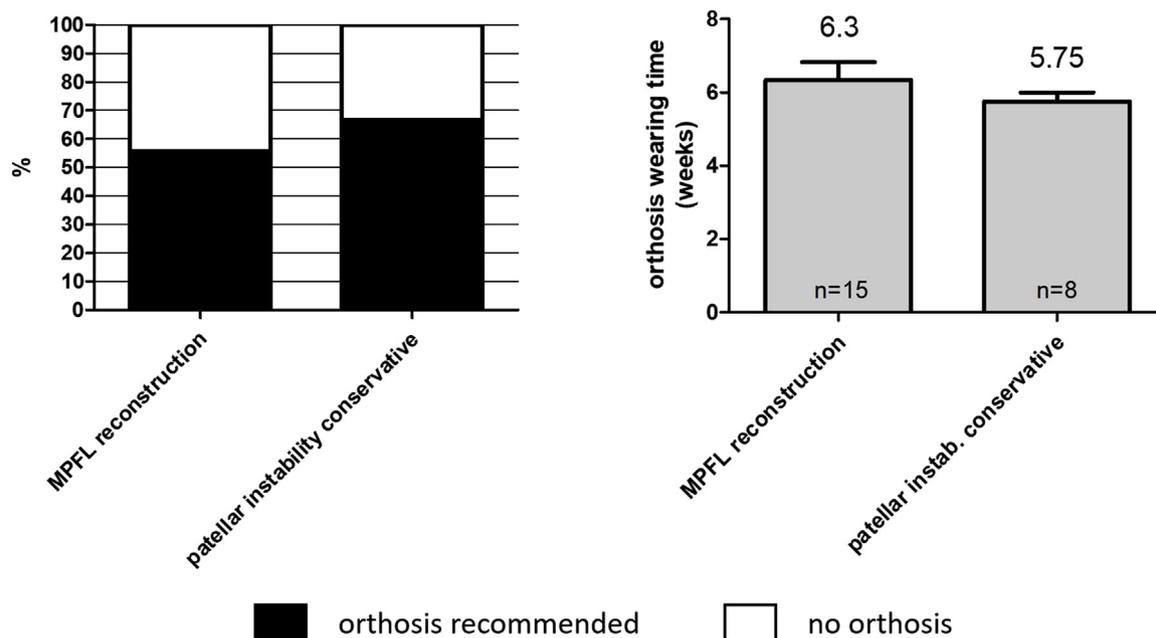


Fig. 4. Protocols with use of orthosis and length of use after patellar dislocation.

immobilization, the ROM should be expanded over 6 weeks and protected by a ROM orthosis [29]. These suggestions were matched by the results of this study. Recovery of full ROM is essential for a return to sports on a level similar to that before injury [30]. The number of only 12 protocols may show a trend to operative treatment after patellar dislocation.

Several approaches to rehabilitation are described in the literature, either directly after the initial phase of immobilization [25,27] or after 6 weeks, particularly after strengthening of the medial vastus muscle to prevent insufficiency and lateral dislocation [19]. On the other hand, specific muscle training during the early rehabilitation phase is not mentioned anywhere because it does not selectively trigger muscle strength [18]; thus, general training is recommended to improve proprioception [25,27]. Careful running exercises have been suggested in the literature after 5–6 weeks, but only in the absence of pain [26]. For a safe

return to sports, the literature shows no defined time tables. Besides a full ROM, further aims are absence of knee swelling and achieving 80% of muscular strength of the quadriceps compared to the healthy leg, at the earliest 6 months after injury [29].

In general, surgery significantly reduces the risk of recurrent patellar dislocation and leads to better results with regard to running and evaluation of the Hughston VAS. Patient satisfaction did not show any significant differences between surgical and conservative treatment concepts [6,8]. Of course, conservative therapy has a lower risk of complications such as infection or cosmetically unsatisfactory scars. Presence of scientific and clinical indications for both surgical and conservative treatment for primary patellar dislocation necessitates a detailed investigation about consensus or differences in current rehabilitation protocols. Particularly recently published literature reports have described specific subpopulations with frequent patellar dislocation and a

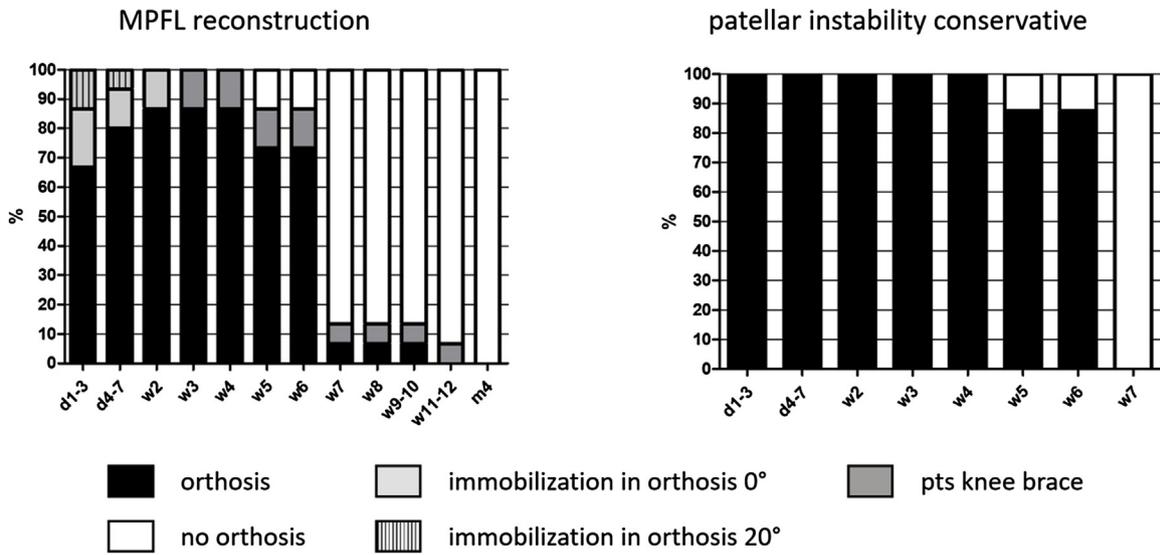


Fig. 5. Overview of timeline in protocols recommending use of orthosis.

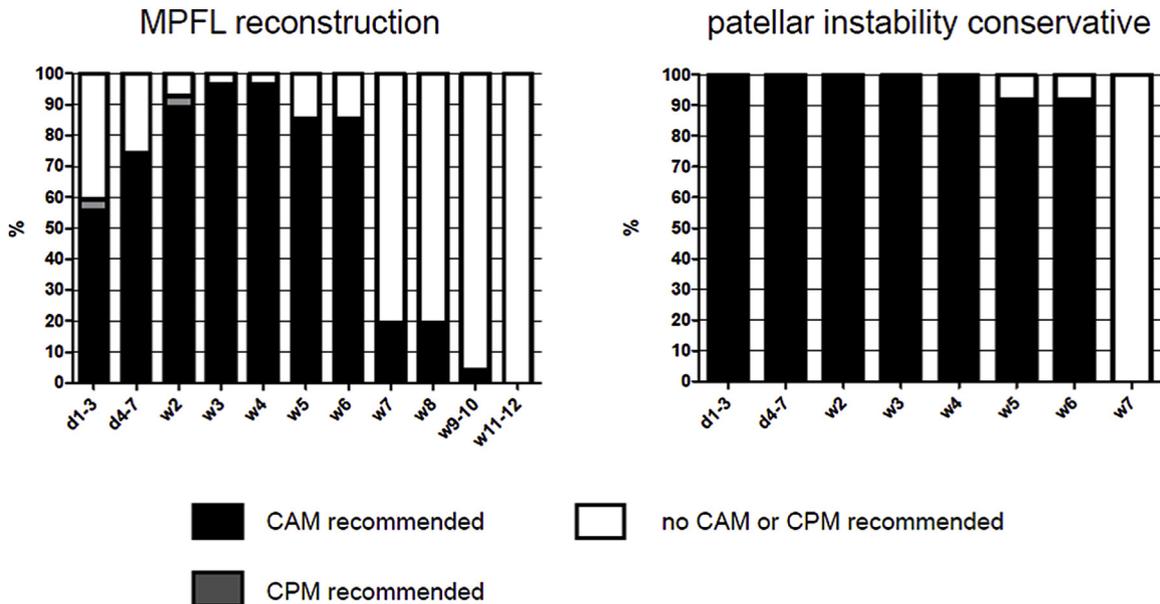


Fig. 6. Treatment with an active movement device (CAM) and a passive movement device (CPM) after patellar dislocation.

higher risk of re-dislocation, for instance overweight adolescent girls because of higher instability in the patellofemoral joint [19], who may profit from primary surgical treatment. More recent findings have shown a similar distribution of patellar dislocation in athletically active patients of both sexes aged between 10 and 20 years [4,28,31]. Because indications for particular treatment concepts in the case of patellar dislocation are determined by several factors, both an individualized therapy strategy and the success of the rehabilitation concept are essential.

This paper has some limitations; the data sample is only a summary of standardized physicians' protocols and does not include factors such as the compliance and performance of patients. The protocols only cover the early phase after start of treatment with 6 until 12 weeks, but the rehabilitation period after patellar dislocation is generally much longer. A description of follow-up data is also missing because no information on treatment results, mid- or long-term aspects, or functional outcome is provided. Also, only 12 protocols were available for

conservative treatment compared to 27 protocols about surgically treated patellar dislocation.

In conclusion, current protocols for the early rehabilitation period after primary patellar dislocation were investigated in this study for the first time. Surgical and conservative treatment concepts differed, and no early functional rehabilitation strategies were applied directly after trauma.

Conflict of interest

The authors are not compensated and there are no other institutional subsidies, corporate affiliations, or funding sources supporting this work unless clearly documented and disclosed.

Ethical approval

This article does not contain any studies with human participants or animals performed by any of the authors.

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