Return to Physical Activity Following Flatfoot Reconstruction

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Abstract

Background: Progressive collapsing foot deformity (PCFD) is a debilitating condition encompassing several interrelated, progressive deformities requiring a combination of reconstructive procedures. Few studies investigate returns to activity following flatfoot reconstruction, and existing studies only examine 1 or 2 of the numerous procedures employed. This study aims to provide the first generalizable assessment of returns to sports and physical activity following reconstruction surgery in patients with flexible flatfoot deformity.

Methods: Patients aged 18-60 years who underwent reconstructive surgery between February 16 and May 19 for symptomatic flexible-stage flatfoot deformity were identified by registry review. Eighty-two of 113 eligible patients (73%) were reached at a mean 2.9 years (range, 2.0-5.4) of follow-up with mean age at surgery of 48.9 years (range, 18-59). Returns to physical activity were evaluated with a sports-specific survey. Clinical outcomes were evaluated with Patient-Reported Outcomes Measurement Information System (PROMIS) scores.

Results: Patients reported participation in 21 specific sports and activities. One-fourth (25.6%) of patients (21/82) reported increased difficulty with physical activities postoperatively, 15.9% reported equal difficulty, and 58.5% (48/82) reported decreased difficulty. Median return times were 9-12 months for participation and 12-18 months to reach maximum preoperative participation levels. Improvements in Physical Function (P=.001), Pain Interference (P<.001), Pain Intensity (P<.001), and Global Physical Health (P=.004) were associated with increased satisfaction with respect to sports and physical activities.

Discussion: This study investigated participation in specific sports and physical activities following flatfoot reconstruction. Our findings suggest mixed outcomes, where many patients reported life-changing improvements but many also experienced prolonged pain and difficulty after surgery. Some patients reported increased difficulty or inability to return to their preoperative maximum level of participation, indicating that flatfoot reconstructions can lead to athletic limitations.

Conclusion: Although flatfoot reconstruction can be a powerful tool to increase patients’ capacity to engage in physical activity, in our cohort many patients had reduced physical activity outcomes.

Level of Evidence: Level IV, retrospective case series.

Keywords: progressive collapsing foot deformity, return to sport, flatfoot reconstruction, physical activities

Introduction

Progressive collapsing foot deformity (PCFD), also known as adult-acquired flatfoot deformity, is a debilitating condition encompassing multiple interrelated, progressive components including medial arch collapse, hindfoot valgus, and forefoot abduction.10 As etiology and presentation differ among patients, no singular best option exists for operative treatment of patients with flatfoot deformities, particularly in the flexible stages of the condition.9,19 Rather,
flexible deformities are corrected with a combination of bony and soft tissue procedures used to restore the medial arch, neutralize heel alignment, address PTT insufficiency, and correct forefoot abduction, among other goals. Previous studies demonstrate good clinical and radiographic outcomes following flatfoot reconstruction surgeries. However, literature on return to physical activities after reconstruction surgeries is limited.

Very little literature investigates returns to activity following flatfoot reconstruction. Existing studies are limited by small sample sizes, lack of sport-specific data, and patient populations confined to 1 or 2 of the many possible procedures used in flatfoot reconstruction. Usuelli et al reported the only sport-specific study on returns to activity following flexor digitorum longus (FDL) transfer to the navicular and medializing calcaneal osteotomy (MCO), finding that 86% (36/42) of patients could return to desired activities. However, given their small sample size and the many different procedures surgeons perform to correct PCFD, more generalizable research is needed to set preoperative expectations and guide decision making.

This study assesses return to sports and physical activity following reconstruction surgery in patients with flexible flatfoot deformity. We used a previously published sports questionnaire to evaluate participation in specific activities, reporting outcomes including number of sessions per week, session durations, pre- to postoperative difficulty changes, and overall patient satisfaction with return to activity. We also assessed whether return to physical activity is correlated with the Patient-Reported Outcomes Measurement Information System (PROMIS) score, a validated patient-reported outcome measure in foot and ankle literature.

Materials and Methods
This was a single-center retrospective study, with a protocol approved by the Foot and Ankle Registry Steering Committee at the investigators’ institution. The IRB-approved registry was retrospectively reviewed to identify patients who underwent a flatfoot reconstruction surgery between February 2016 and May 2019 by one of 8 fellowship-trained foot and ankle orthopaedic surgeons. Operative notes were reviewed, and all procedures performed were noted. Inclusion criteria included patients who underwent reconstruction surgery for symptomatic flexible flatfoot deformity with a minimum follow-up of 2 years. Excluded patients included those who were 60 or older, had rigid flatfoot deformity, or did not have a minimum follow-up of 2 years. The age cut-off chosen, higher than in similar previous studies, reflects a more typical patient undergoing flatfoot reconstruction, yet still selects a group that may be interested in participating in sports after surgery. Patients were also excluded if they had systemic or musculoskeletal disease that affected physical activity or who underwent other major surgeries between their flatfoot reconstruction surgery and the time of review. For 3 patients who underwent flatfoot reconstruction on both feet, only the ultimate recovery, referencing the second surgery, was included. No patients underwent simultaneous bilateral procedures. Patients with first tarsometatarsal fusions were included, although patients who experienced postoperative malunion or nonunion following arthrodesis procedures were excluded. The incidences of each specific procedure performed are listed in Table 1. In total, 113 patients were identified as meeting the inclusion and exclusion criteria. Eighty-two eligible patients were contacted by telephone, gave informed consent to participate, and filled out the survey, yielding a response rate of 73% (82/113). Median age at surgery was 48.9 (range, 18-59) years. In terms of sex, 24.4% of patients were male (20/82) and 75.6% were female (62/82). Average follow-up time was 2.9 (range, 2.0-5.4) years. The talonavicular coverage angle (TNCA) was measured on each patient’s preoperative weightbearing radiograph.

Operative Techniques
All PCFD reconstruction surgeries were performed by one of 8 fellowship-trained foot and ankle orthopaedic surgeons at our institution. The operative algorithm for surgical correction was consistent with decision making previously described by Day et al. Postoperatively, patients recovered in a nonweightbearing splint for 2 weeks, then nonweight-bearing in a controlled ankle motion boot for an additional 2 weeks, followed by progression of weight over 4 weeks in a boot before weaning to a shoe by 12 weeks. Patients were advised that they could return gradually, as capable, to low-impact activities within 4-5 months and to all activities between 6 and 9 months.

Sports and Physical Activities
Sports and physical activity participation were evaluated with a retrospective physical activity and sports-specific questionnaire (SQ) administered at a minimum of 2 years postoperatively. This questionnaire has been previously used to assess physical activity following various foot and ankle procedures and was developed through consultation with a clinical epidemiologist. The SQ assessed participation in 15 common sports and physical activities before and after surgery, including low-impact activities (swimming, golf, bicycling, yoga/Pilates, walking, exercise machine) and high-impact activities (football, basketball, dance/aerobics, running, hockey, lacrosse, weightlifting, tennis, soccer, squash). Patients could list up to 3 other activities they participated in if not already listed in the survey. To minimize the effects of recall bias, patients were not asked to report preoperative levels of participation in any
sports or activities; instead, they simply reported whether they had participated in the activity preoperatively. For postoperative participation, patients were asked to specify the number of sessions per week in each activity, session durations, the number of months after surgery until they returned to participation, as well as the time it took to reach their maximal level of activity, or if they never achieved their maximal level.

Based on their postoperative participation levels, patients were classified as either sedentary (0 hours/wk), moderately active (up to 5 hours/wk), highly active (5-10 hours/wk), or extremely active (greater than 10 hours/wk) according to a scheme first published by Valderrabano et al.18 Patients were also asked whether each activity was more, equally, or less difficult postoperatively compared with preoperatively. Only activities that were performed both preoperatively and postoperatively were included in the difficulty assessment. Relative difficulty data were then tallied to report on net pre- to postoperative difficulty for each patient. Finally, the survey assessed patients’ overall levels of satisfaction with their operative outcome regarding their ability to return to sports and physical activities.

Clinical Outcomes
PROMIS scores were collected at a minimum of 2 years postoperatively for 75 of 82 cases. PROMIS is a patient-administered questionnaire assessing various dimensions of patient outcomes. PROMIS Physical Function, Pain Interference, Pain Intensity, Global Physical Health, Global Mental Health, and Depression scores were evaluated. PROMIS has been specifically validated for several foot and ankle conditions including PCFD and has been shown to perform as well or better than the FAOS, a reliable and well-performing patient-reported outcome survey, in all aspects of psychometric validity.1 For each PROMIS domain, a higher score indicated a greater extent of the dimension measured.

Statistical Analysis
Descriptive statistics were reported as mean and SD or median and interquartile range for continuous variables and count and percentage for categorical variables. Normality was tested using Shapiro-Wilk tests. Differences between groups were investigated using Mann-Whitney U tests for continuous data and Pearson χ² tests for categorical data. Wilcoxon signed rank tests for paired data were used to investigate differences in preoperative and postoperative PROMIS scores.

Multivariable linear regressions were used to investigate association of each change in PROMIS domain as the independent variable, with sessions per week, session duration, total weekly time, and satisfaction, respectively, as the dependent variable after controlling for age, sex, and body mass index. Furthermore, for the most commonly participated-in sports, Pearson correlation tests were used to investigate the relationship between changes in PROMIS domains

| Procedure                                              | Count | Percentage of Patients |
|--------------------------------------------------------|-------|------------------------|
| Medializing calcaneal osteotomy                       | 79    | 96                     |
| FDL to navicular transfer                             | 62    | 76                     |
| Gastrocnemius recession                               | 53    | 65                     |
| Lateral column lengthening                            | 44    | 54                     |
| First tarsometatarsal fusion                          | 39    | 48                     |
| Posterior tibialis debridement/repair                 | 35    | 43                     |
| Spring ligament repair                                | 28    | 34                     |
| Medial cuneiform osteotomy                            | 27    | 33                     |
| Tibialis posterior tenolysis                          | 25    | 30                     |
| Calcaneal bone graft                                  | 24    | 29                     |
| Flexor hallucis longus to flexor digitorum longus transfer | 22    | 27                     |
| Accessory navicular excision                          | 18    | 22                     |
| Achilles lengthening                                  | 14    | 17                     |
| Modified McBride procedure                            | 14    | 17                     |
| Akin osteotomy                                        | 8     | 10                     |
| Ostectomy of the talus                                | 6     | 7                      |
| Deltoid ligament repair                               | 2     | 2                      |
| Extensor hallucis longus lengthening                  | 1     | 1                      |

Abbreviation: FDL, flexor digitorum longus.

*Patients underwent a wide variety of procedures to correct the various component deformities of progressive collapsing foot deformity.
Table 2. Preoperative and Postoperative Sports and Physical Activities.

| Activity              | Impact Level | Preoperative Participants | Postoperative Participants | Change |
|----------------------|--------------|----------------------------|----------------------------|--------|
| Walking              | Low          | 74                         | 80                         | +6     |
| Biking               | Low          | 37                         | 44                         | +7     |
| Swimming             | Low          | 36                         | 44                         | +8     |
| Machine              | Low          | 38                         | 40                         | +2     |
| Weightlifting        | High         | 30                         | 36                         | +6     |
| Yoga/Pilates         | Low          | 31                         | 36                         | +5     |
| Dancing/aerobics     | High         | 27                         | 30                         | +3     |
| Running              | High         | 17                         | 21                         | +4     |
| Golf                 | Low          | 14                         | 16                         | +2     |
| Tennis               | High         | 8                          | 9                          | +1     |
| Basketball           | High         | 5                          | 6                          | +1     |
| Interval training    | High         | 3                          | 3                          | +0     |
| Soccer               | High         | 1                          | 2                          | +1     |
| Hockey               | High         | 2                          | 2                          | +0     |
| Horseback riding     | High         | 2                          | 2                          | +0     |
| Squash               | High         | 1                          | 1                          | +0     |
| Skiing               | High         | 1                          | 1                          | +0     |
| Kayaking             | Low          | 0                          | 1                          | +1     |
| Boxing               | High         | 1                          | 1                          | +0     |
| Hiking               | Low          | 1                          | 1                          | +0     |
| Karate               | High         | 1                          | 1                          | +0     |
| Total participation  |              | 82 patients in 330 activities | 82 patients in 377 activities | +47  |

*Notes: The table shows the preoperative and postoperative participation in various sports and physical activities, with changes in participation from preoperative to postoperative. The activities are categorized by impact level: low, moderate, high, and very high. The table also indicates the change in participation, with positive numbers indicating an increase in participation postoperatively.

Results

Sports Questionnaire

Patients reported participation in 21 specific sports and activities, with 330 total preoperative activities and 377 total postoperative activities, averaging 4.0 (330/82) preoperative and 4.6 (377/82) postoperative physical activities per patient (Table 2). Preoperatively, patients participated in 2.9 (99/82) high-impact and 2.8 (231/82) low-impact activities per person on average. Postoperatively, they averaged 1.4 (115/82) high-impact and 3.2 low-impact activities per person (262/82). The most common activities reported both pre- and postoperatively were walking, swimming, biking, machine exercise, weightlifting, and yoga/Pilates. No activities were discontinued postoperatively, but across the 82 patients surveyed, there was an average activity adoption rate of 0.57 activities per person (47/82).
Because patients reported participation in multiple activities, which differ in their functional demands of the foot, return to activity timeline data is reported both on an activity-specific basis and as a general distribution of patients’ returns to activity and maximum participation. Activity-specific patient return timeline results are displayed for all reported activities in Table 3. The median return time for all activities taken together was 9-12 months, with median return times of 6-9 months and 9-12 months for low- and high-impact activities, respectively. The median time for patients to return to maximum participation was 12-18 months for all activities taken together, as well as for the subgroups of high- and low-impact activities. Figures 1 and 2 show all patient-reported returns to activity and maximum preoperative participation level to demonstrate the distribution of timelines for both parameters for high-impact, low-impact, and overall activities.

Postoperatively, survey respondents spent a median 7.5 hours per week (range, 0-20.25 hours) exercising, with a median 12 sessions per week (range, 0-34) and a median of 30 minutes (range, 0-2 hours) per session. Using the Valderrabano scale referenced earlier, 2 of 82 patients (2.4%) were sedentary, 26 of 82 patients (31.7%) were moderately active, 24 of 82 (29.3%) were highly active, and 30 (36.6%) were extremely active (Figure 3).

Twenty-one of 82 patients (25.6%) reported net increases in difficulty across the different physical activities they participated in, whereas 13 of 82 patients (15.8%) reported the same overall difficulty level, and 48 of 82 patients (58.5%) reported that activities were less difficult postoperatively (Figure 3). No association was found between activity impact level and pre- to postoperative difficulty changes \( (P = .45) \).

Reasons for increased difficulty were described by 22 patients (Table 4). Overall, 90.2% of patients (74/82) were satisfied with their operative outcomes regarding returns to physical activities, with 46.3% (38/82) very satisfied, 24.4% (20/82) satisfied, 19.5% (16/82) somewhat satisfied, and 9.8% (8/82) dissatisfied (Figure 4).

**Clinical Outcomes**

As expected, patients experienced significant improvements in all PROMIS domains except Depression. Physical Function improved by 8.7 points (41.4-50.1, \( P < .001 \)), Pain Interference by 10.9 points (61.0-50.1, \( P < .001 \)), Pain Intensity by 9.5 points (50.0-40.5, \( P < .001 \)), Global Physical Health by 9.2 points (44.9-54.1, \( P < .001 \)), and Global Mental Health by 2.5 points (50.8-53.3, \( P = .02 \)). The improvements in Physical Function and Pain

| Activity                | Median Return Time, mo | Median Time to Maximum Preoperative Participation, mo | Count |
|-------------------------|------------------------|------------------------------------------------------|-------|
| All activities          | 9-12                   | 12-18                                                | 377   |
| Low-impact activities   | 6-9                    | 12-18                                                | 262   |
| High-impact activities  | 9-12                   | 12-18                                                | 115   |
| Walking                 | 6-9                    | 12-18                                                | 80    |
| Biking                  | 6-9                    | 12-18                                                | 44    |
| Swimming                | 6-9                    | 9-12                                                 | 44    |
| Machine                 | 9-12                   | 12-18                                                | 40    |
| Weightlifting           | 6-9                    | 9-12                                                 | 44    |
| Yoga/Pilates            | 9-12                   | 18-24                                                | 36    |
| Dancing/aerobics        | 9-12                   | 18-24                                                | 30    |
| Running                 | 9-12                   | 12-18                                                | 21    |
| Golf                    | 9-12                   | 18                                                  | 16    |
| Tennis                  | 12-18                  | 12-18                                                | 9     |
| Basketball              | 9                      | 18                                                  | 6     |
| Interval training       | 12-18                  | 12-18                                                | 3     |
| Soccer                  | 12-18                  | 18-24                                                | 2     |
| Hockey                  | 12-18                  | 24                                                  | 2     |
| Horseback riding        | 6                      | 6-9                                                 | 2     |
| Squash                  | 18-24                  | 18-24                                                | 1     |
| Skiing                  | 12-18                  | 18-24                                                | 1     |
| Kayaking                | 12-18                  | 18-24                                                | 1     |
| Boxing                  | 9-12                   | 12-18                                                | 1     |
| Hiking                  | 12-18                  | 12-18                                                | 1     |
| Karate                  | <6                     | 6-9                                                 | 1     |

\(^a\)As the number of patients who participated in each activity decreases, the data become increasingly anecdotal. Clinicians should exercise judgment when setting patient expectations.
Although the vast majority of patients returned to physical activity within a year, a substantial proportion of patients took nearly 2 years to return to participation. Return times were generally longer for high-impact activities.

The majority of patients returned to their maximum preoperative level of participation, defined as their participation level prior to needing corrective surgery for progressive collapsing foot deformity, within 12-18 months. However, a substantial percentage of patients never reached their maximum preoperative participation level, indicating persistent and debilitating issues.
Interference were substantially greater than the reported minimal clinically important differences for PCFD of 3.2 points and 3.7 points on the PROMIS PF and PI subscales, respectively.4

**Associations Between PROMIS and Sports Questionnaire**

Multivariable linear regression models revealed significant associations between changes in PROMIS domain and return parameters as assessed at minimum 2 years postoperatively. A greater number of sessions per week was associated with greater improvement in Physical Function (\( P = .008 \)). Longer session durations were associated with greater improvements in Physical Function (\( P = .033 \)) and in Pain Interference (\( P = .038 \)). Greater satisfaction with respect to physical activity participation was associated with greater improvements in Physical Function (\( P = .001 \)), Pain Intensity (\( P < .001 \)), and Global Physical Health (\( P = .0043 \)).

Pearson correlation tests were used to identify correlations between changes in PROMIS domains and participation levels for the 4 most common physical activities: walking, swimming, biking, and weightlifting. For walking, session duration was weakly positively correlated with improvement in Global Physical Health (\( \rho = .306, P = .018 \)). For swimming, session duration was positively correlated with improvement in Global Physical Health (\( \rho = .325, P = .047 \)). No correlations were found between PROMIS scores and participation levels in biking or weightlifting.

**Associations Between Specific Procedures and Outcomes**

Mann-Whitney \( U \) tests and Pearson \( \chi^2 \) tests were used to identify differences in demographic variables, PROMIS scores, and SQ parameters between patients who had and had not received any of the procedures analyzed. No differences could be detected in SQ parameters between those who had and had not received any of the procedures analyzed, given the number of patients available. Additionally, although there were differences in various PROMIS domain outcomes for several procedures, almost all coincided with differences in demographics between those who had and had not undergone them. The sole exception was lower
postoperative Pain Intensity (37.5 vs 41.0, \( P = .044 \)) and Pain Interference (48.3 vs 52.3, \( P = .042 \)) in patients who underwent lateral column lengthening, despite no differences in body mass index, sex, age, follow-up time, or preoperative PROMIS scores between the 2 groups.

Stratified Patient Characteristic Analyses

Patients aged >40 years (57 patients) reported worse preoperative Physical Function than the (25) younger patients (38.8 vs. 42.2, \( P = .047 \)). There were no differences in any other preoperative or postoperative PROMIS domains or return to activity parameters between the 2 groups. Additionally, there were no differences in any of the aforementioned variables between patients with TNCA >40 degrees (22 patients) and patients with TNCA <40 degrees (60 patients).

Discussion

This study investigated participation in specific sports and physical activities following flatfoot reconstruction. Our

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**Table 4. Reasons for Increased Activity Difficulty.**

| Reason                  | No. of Patients | Percentage of Cohort |
|-------------------------|-----------------|----------------------|
| Pain                    | 7               | 9                    |
| Change in gait or balance | 5              | 6                    |
| Weakness                | 4               | 5                    |
| Fatigue                 | 2               | 2.5                  |
| Uncomfortable hardware  | 2               | 2.5                  |
| Swelling                | 1               | 1                    |
| Difficulty with footwear| 1               | 1                    |

* A total of 22 patients cited reasons for increased difficulty with sports and physical activities. The most commonly cited reasons for increased postoperative difficulty were pain, changes in gait or balance, and weakness.

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**Figure 4.** More than 90% of patients surveyed reported at least some degree of satisfaction with their ability to participate in desired sports and physical activities following surgery.
findings suggest mixed outcomes, where many patients reported life-changing improvements but many also experienced prolonged pain and difficulty after surgery. Patients reached their maximum level of preoperative participation in more than 75% of activities, and postoperative physical activities were either less difficult or the same difficulty overall compared to preoperatively for 75% of patients. No patients reported ceasing activities postoperatively, and many reported initiating new activities. Patients were highly active after surgery: 36% of patients spent more than 10 hours per week on physical activities and an additional 29% spent between 5 and 10 hours per week on physical activities. Ultimately, more than 90% of patients were satisfied with their outcome regarding participation in sports and physical activities. Patient satisfaction with respect to physical activity participation was correlated with improvements in PROMIS Physical Function, Pain Interference, Pain Intensity, and Global Physical Health, indicating that good clinical outcomes predict patients’ ability to return to activities they desire.

However, returns to activity varied, with many patients reporting suboptimal outcomes. Key findings include the fact that a substantial proportion of patients (18%) take nearly 2 years to return to participation in any given activity, and some (22%) never reach their maximum preoperative levels of participation. Moreover, >40% of patients did not experience improvements in difficulty, with 26% reporting that their net difficulties were actually greater postoperatively. Although most patients undergoing flatfoot reconstruction experience marked improvements in their ability to participate in sports and physical activity, challenges persist for many. Additionally, although there were no differences in return parameters based on procedures patients underwent, patients undergoing lateral column lengthening experienced better clinical outcomes at a minimum of 2 years than patients who did not, a finding that may interest clinicians. Although not all flatfeet are the same, there were no pre- or postoperative differences between patients who had severe preoperative forefoot abduction and those who did not.

To date, this is the largest and most comprehensive analysis of participation in sports and physical activities following flatfoot reconstruction. In contrast with the few existing studies in the literature, which examine cohorts numbering around 30 to 40 patients, the 82-patient cohort in this study allows collection of activity-specific information on a greater range of activities as well as analysis of relationships between return to activity and the specific component procedures employed in surgery. Moreover, the use of the Sports Questionnaire enables more thorough reporting on various aspects of returns to activity including associated changes in difficulty, frequency and duration of participation, return times to participation and maximum levels thereof, and satisfaction with respect to physical activity participation. These specific metrics are unique to this study and will allow surgeons to better counsel patients about expectations regarding specific activities. They also enable confirmation of previous findings with the use of a more detailed outcome tool. Finally, we assessed correlations in physical activity and sports participation with PROMIS, a validated clinical outcomes measure. This is a novel aspect of the study made possible by its larger sample size compared with previous studies.

This study has several limitations. There may have been a response bias, wherein patients experiencing worse outcomes may not have responded for follow-up. Da Cunha et al, in a similar study on returns to physical activity following first metatarsophalangeal arthrodesis for hallux rigidus, report a lower response rate of 68% (50/73) compared to our 73% (82/113). However, in similar studies on first tarsometatarsal fusion for hallux valgus and primary partial arthrodesis for Lisfranc injuries, MacMahon et al report rates of 83% (48/58 and 38/46, respectively). Next, the Sports Questionnaire has not been validated, although it was developed with a clinical epidemiologist and has published previously. Although this study includes patients who underwent flatfoot reconstruction from any of 8 fellowship-trained foot and ankle surgeons, we believe that this fact makes our findings more generalizable.

Few studies have investigated returns to sports and physical activities after flatfoot reconstruction. Tellisi et al examined functional outcomes of flexible-stage flatfoot patients aged ≤50 years, and reported successful returns to generalized physical activities. They evaluated 34 feet in 30 patients with mean age 41.2 years using American Orthopaedic Foot & Ankle Society (AOFAS)-hindfoot scores, the 36-Item Short Form Health Survey score, and a survey where patients preoperatively and postoperatively rated their activity level, from inability to walk to active participation in running or sports. They found that most patients experienced improved physical function and could manage walking for exercise or running and playing sports. This is similar to our finding of decreased difficulty across activities and greater participation postoperatively. However, their study included 30 patients, did not assess for specific activities, and offered no information on timelines for return.

Usuelli et al published a series of 42 consecutive patients with mean age of 41 years (range 19-74) undergoing MCO with flexor digitorum longus–navicular transfer to assess several parameters on returns to physical activity. They collected data on extent of participation (hours/wk), specific activities and their impact levels, and time until participation after surgery. Generally, our findings expand on theirs; they observed increased activity after surgery, both in the number of activities patients participated in and the time spent participating each week. In their study, 27 of 42 (64%) were engaged in athletic activities preoperatively,
and 36 of 42 (86%) participated postoperatively. They found that patients returned to physical activities at an average of 3.6 months after reconstructive surgery. Here, our results differed, as we found that median return time was between 6 and 9 months and that some patients did not fully return to all activities until 2 years after surgery. It is likely that our results better represent the overall population of patients who undergo flatfoot reconstruction. Most patients undergo not just MCO and flexor digitorum longus transfer but also multiple concomitant procedures such as gastrocnemius recessions, Achilles lengthening, lateral column lengthening, and first tarsometatarsal fusion. These more complex operations likely contribute to longer return times and are more typical of the general population of patients undergoing flatfoot reconstruction. The current study excludes patients >60 years, thereby minimizing the potential interference of physical activity limitations induced by age rather than flatfoot reconstruction.

Finally, Martinelli et al.15 compared 30 patients who underwent MCO and concomitant naviculocuneiform arthrodesis with 31 healthy controls to assess several quality-of-life parameters including physical activity. They found significant clinical improvements, but lower levels of quality of life and physical activity among patients who underwent the aforementioned surgeries to reconstruct a symptomatic flatfoot. Their results confirm their findings of significant improvement after surgery and generally good, albeit mixed, returns to activity. However, like Tellisi et al.,16 they do not assess specific activities, and, like Usuelli et al.,17 they confine their investigation to a small subset of potential flatfoot reconstruction patients.

A pattern emerges when comparing the returns to activity for flatfoot reconstruction patients from this study to previous return to activity studies using the same Sports Questionnaire. It appears that the typical flatfoot reconstruction patient may have a greater improvement in their ability to return to physical activities, but that higher numbers of patients experience suboptimal returns. In their 2019 study on first metatarsophalangeal fusion for hallux rigidus, Da Cunha et al.1 report lower levels of physical activity, with less favorable changes in pre- to postoperative difficulty. However, they report a higher overall satisfaction rate and fewer patients with protracted returns to activity or inability to reach maximum preoperative participation. MacMahon et al.14 do not collect data on return timelines in their 2 studies, but they report higher overall satisfaction despite lower activity levels and markedly worse pre- to postoperative difficulty changes for primary partial arthrodesis to treat Lisfranc injuries. Meanwhile, their study on the modified Lapidus procedure to correct hallux valgus suggests a similar phenomenon to our data, wherein postoperative activity levels and pre- to postoperative difficulty changes compare favorably to the other studies, but fewer patients report satisfaction.13

In conclusion, this study adds to previous literature suggesting that flatfoot reconstruction surgery generally results in good returns to physical activity, but that many patients experience prolonged issues like pain and weakness that inhibits desired participation in sports and physical activities. Patients could return to a wide range of sports and physical activities. The majority returned to participation within a year and to their maximum preoperative levels of activity within 12-18 months. Many could initiate new sports and physical activities, and overall, more than 90% of patients surveyed reported satisfaction with their outcomes with respect to return to physical activity. Although almost every activity assessed was either less difficult or the same difficulty for most patients, some patients did report increased difficulty or inability to return to their preoperative maximum level of participation, indicating that flatfoot reconstructions can lead to athletic limitations. In some cases, patients took 2 years to fully return to activities, and some never reached their preoperative maximum level of participation. The findings presented here may be beneficial for counseling patients pre- and postoperatively to provide a better understanding of the impacts and risks of flatfoot reconstruction surgery in helping patients return to the activities they enjoy. Further research is necessary to optimize flatfoot reconstructions and increase the likelihood of successful postoperative returns to sports and physical activities.

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