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LOWER EXTREMITY REVIEW

September 23 / volume 15 / number 9

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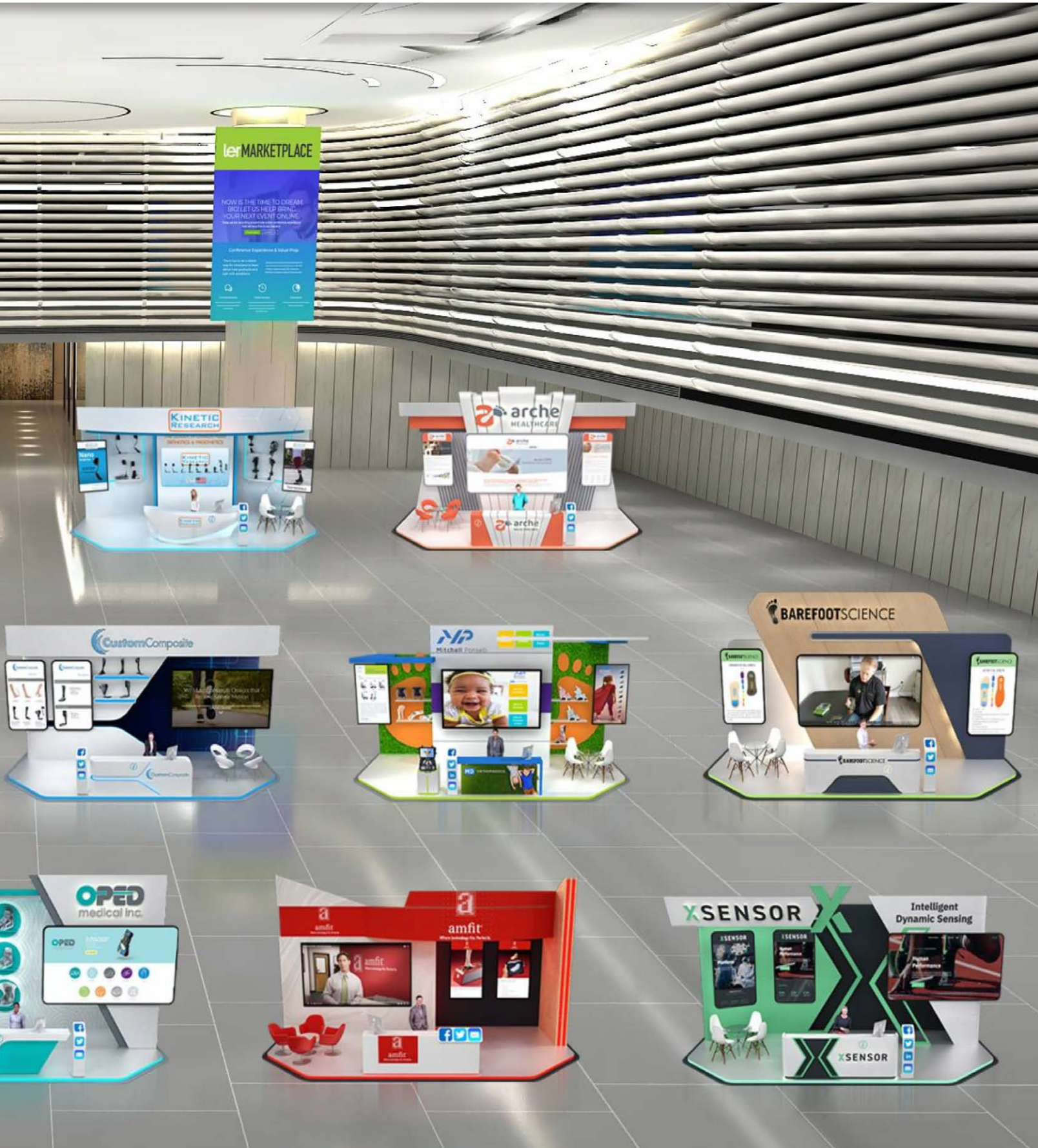

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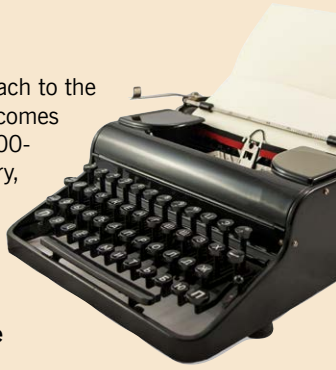

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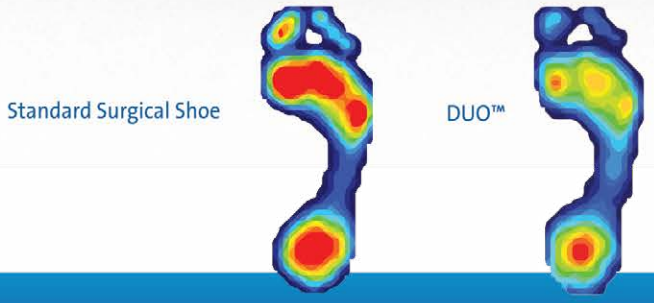

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Guest **Perspective**

Video Education and Knee Osteoarthritis

By Thorlene Egerton, Joanne Bolton, Camille E. Short, and Kim L. Bennell

Patient education is the most commonly used intervention for chronic disease management. Education interventions have variably been shown to have benefits for chronic disease management in general and musculoskeletal pain disorders more specifically. Although impacts are modest, education interventions are accepted as an important part of multi-component behavior change interventions. Knee osteoarthritis (OA) is a highly prevalent, chronic painful condition with no cure, and recommended care focusses on education and self-management behaviors. Education is recommended as a core component of knee OA management, yet not all education is beneficial – it can do harm via the nocebo effect whereby expectation of symptom worsening is unintentionally promoted. People who are fearful of activity because of their understanding of their joint damage are less likely to engage in the very treatment that can alleviate symptoms and preserve joint functioning. Education for people with knee OA has received little research attention and little is known about the comparative impacts of different types of education.

The potential benefits of education interventions for knee OA include improvements in psychosocial outcomes, pain, function, and markers of disease. To achieve these benefits, education should not just share information about the disease process but develop a patient mindset and level of understanding that facilitates ongoing physical activity, participation and well-being. Education should aim to activate the person to self-manage through changes in behavioral determinants such as expectations, motivation and self-efficacy. Traditional patient education

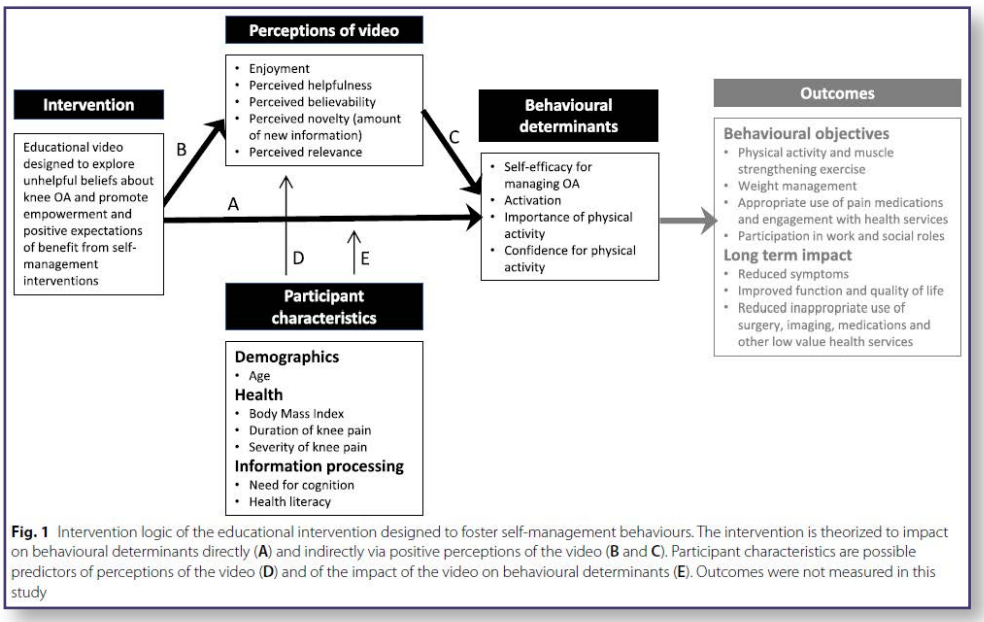

Fig. 1 Intervention logic of the educational intervention designed to foster self-management behaviours. The intervention is theorized to impact on behavioural determinants directly (**A**) and indirectly via positive perceptions of the video (**B** and **C**). Participant characteristics are possible predictors of perceptions of the video (**D**) and of the impact of the video on behavioural determinants (**E**). Outcomes were not measured in this study

for people with knee OA focuses on structural damage (eg, cartilage degeneration or 'wear and tear') and an expectation of disease progression (eg, symptoms will progress and surgery is inevitable). This type of information is typical of education currently delivered by healthcare professionals as well as via written and online resources. This information has been shown to foster negative outcome expectation, fatalism, and activity avoidance in people with knee OA. Previous research suggests that patient education for people with musculoskeletal pain delivered with a biopsychosocial approach and messages of empowerment and positive expectation of benefit from conservative options, may be more beneficial than traditional disease information approaches. Our own qualitative study[1] exploring the reactions of people with painful knee OA to a brief educational video with novel empowerment content including psychosocial components of the condition, found most participants responded favorably. Many declared an intention to add at least one effective self-management behavior. However, there was a range of responses and a small proportion reported less favorable reactions to the video. These included frustration (eg, because the information was not what they wanted to hear) and some resistance either because the information was at odds with their beliefs or advice from their doctor, or because they perceived the recommendations did not apply to their personal situation. This variability in responses warrants further exploration in order to optimize utilization of low-cost, scalable education and target enhanced education approaches.

This quantitative study aimed to further explore responses to this educational video. The video utilizes presentation features and content that moves away from the more common biomedically based-education and pathoanatomical approaches to explaining and managing the disease. It avoids pictures of structural damage and

This article has been excerpted from "Exploring changes, and factors associated with changes, in behavioural determinants from a low-cost, scalable education intervention bout knee osteoarthritis: An observational cohort study," by the authors listed above. BMC Musculoskeletal Disorders. 2021;22:862. https://doi.org/10.1186/s12891-021-04751-2. Tables have been renumbered and references have been removed for brevity. Use is per Creative Commons License CC BY 4.0.

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does not describe severity in terms of imaging results. It was designed to communicate positive expectations about the effects of self-management behaviors with optimism for one's future prognosis. Our rationale for how the educational video would achieve benefits for people with knee OA is depicted in the proposed intervention logic (Figure 1).

The study had three objectives. Firstly, to investigate whether the behavioral determinants targeted by the intervention (self-efficacy for managing OA, 'activation' i.e. attitude toward self-management, importance of physical activity, and confidence to be sufficiently physically active) changed immediately after watching the video (analysis A). The second objective was to describe viewer perceptions of the video (enjoyment, helpfulness, believability, novelty and relevance) (analysis B), and then explore whether viewer perceptions were associated with changes in behavioral determinants (analysis C). The third objective was to identify participant characteristics (age, health status and information usage attributes, i.e. health literacy and need for cognition) that were associated with viewer perceptions (analyses D) and/or changes in behavioral determinants (analysis E).

Significance

Successful adult patient education is a planned intervention, grounded in adult learning theory, with multiple components that need careful consideration. Exploring potential causal pathways explaining the effect of this novel educational intervention may help to identify characteristics that are important for educational interventions for this patient population. Since people function in complex social and physical environments and bring a range of personal attributes and health beliefs to their self-management of any health condition, understanding the participant characteristics that may indicate who will/will not benefit from this low cost, scalable education intervention may help with planning more tailored implementation strategies and optimize utilization.

Methods: Seventy-eight participants with knee OA (77% female, mean age 63.0 ± 8.7) watched the 9-min video that included evidence-based content and was designed to foster empowerment to self-manage effectively. Data were collected by online questionnaire at baseline and immediately after watching the video. Associations were tested between baseline health and information processing characteristics (health literacy, need for cognition*), perceptions of the video (enjoyment, helpfulness, believability, novelty and relevance) and pre-post changes in behavioral determinants (self-efficacy for managing arthritis, attitude to self-management or 'activation', and importance/confidence for physical activity). *(*Need for cognition: higher score signifies greater need for cognition [which is indicative of a tendency to enjoy effortful cognitive activities].)*

Table Results for pre-post (within-group) comparison ($n = 78$)

	Baseline (mean ± SD)	Follow-up (mean ± SD)	Change (mean ± SD, 95% confidence interval)
Arthritis Self-Efficacy Scale (ASES):[a]			
Pain subscale (5 items, 1–10)	5.8 ± 1.7	7.2 ± 1.8	1.4 ± 1.8, 1.0 to 1.8
Function subscale (3 items, 1 10)	6.4 ± 2.7	7.5 ± 2.4	1.1 ± 1.4, 0.8 to 1.4
Other symptoms subscale (6 items, 1–10)	6.2 ± 1.6	7.4 ± 1.6	1.3 ± 1.4, 0.9 to 1.6
Patient Activation Measure (PAM)[a]			
Average of 13 items (1–4)	3.3 ± 0.4	3.5 ± 0.4	0.23 ± 0.35, 0.16 to 0.31
Importance of regular physical activity (0–10)[a]	8.8 ± 1.5	9.3 ± 1.1	0.4 ± 1.3, 0.1 to 0.7
Confidence can achieve sufficient physical activity (0–10)[a]	6.6 ± 2.5	7.4 ± 2.1	0.8 ± 2.0, 0.4 to 1.3

[a] higher score indicates better/greater

Results: All behavioral determinants improved immediately after watching the video (Table). Positive perceptions were associated with greater improvements in self-efficacy for arthritis (Spearman's rho, ρ = 0.26–0.47). Greater perceived relevance was associated with increased self-rated importance of being physically active (ρ = 0.43). There were small positive associations between health literacy domains related to health information and positive viewer perceptions of the video. People with higher need for cognition may achieve greater improvement in confidence to be physically active (ρ = 0.27).

Conclusion

This study adds further support that positively framed video information about knee OA with an emphasis on empowerment for self-managing with physical activity and exercise may be beneficial. Findings are suggestive, though not conclusive, that short term benefits may include improvements in self-efficacy, activation, and motivation/confidence to be physically active. The video investigated in this study appears to be slightly better received by people with higher health literacy and higher need for cognition, as these characteristics were associated with more positive perceptions of the video and greater increase in confidence for physical activity respectively. Further research is needed to confirm these findings, but it is recommended that designers of empowerment education for people with knee OA strive to engage those with lower health literacy and lower need for cognition. Our findings also suggest that education interventions that are enjoyable and perceived to be helpful, and relevant to the individual may have greater effect. Thus, efforts by health professionals to help people with knee OA to perceive the information is being relevant to them personally may optimize the potential for the video to increase motivation and confidence to be physically active. ler

Reference

1. Egerton T, McLachlan L, Graham B, Bolton J, Setchell J, Short CE, et al. How do people with knee pain from osteoarthritis respond to a brief video delivering empowering education about the condition and its management? Patient Educ Couns. 2021;104(8):2018–27.

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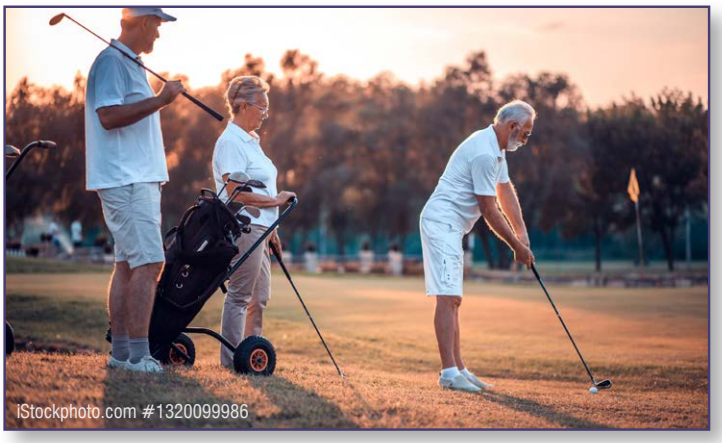

PLAYING GOLF = NORDIC WALKING

Older adults may gain more health benefits from playing golf than participating in regular or Nordic walking, suggests a recent study published in *BMJ Open Sport &Exercise Medicine*.

The health advantages of aerobic exercise in helping to prevent cardiovascular diseases are well documented as part of efforts to stave off high blood pressure, diabetes, and dyslipidemia.

However, most relevant studies have tended to focus on younger people participating in acute bouts of exercise lasting 30 to 60 minutes at moderate to high intensity with less information available on the impact of exercise on older people.

Golf, walking, and Nordic walking—an enhanced walking technique in which people use poles to work their upper body as well as their legs—are popular age-appropriate forms of outdoor aerobic exercise that are safe and easily accessible for many older people.

A team of researchers from Finland set out to compare the acute effects of these 3 different types of aerobic exercises on markers of cardiometabolic health in terms of intensity, duration, and energy expenditure.

They studied 25 healthy older golfers (age 65 and above), comparing the effects of 3 acute aerobic exercises—an 18-hole round of golf (18-hole golf round in Tarina Golf's old course [course profile: flat; length from red tees: 4477 m] by pulling-a-trolley walking in 2–3-player groups), 6km of Nordic walking , and a 6km walk (predetermined walking routes [profile: flat; length: 6000 m] for Nordic walking and walking)—on their blood pressure, blood glucose, and blood lipid profile in a real-life environment.

For the study, the researchers took blood samples, blood glucose finger-prick tests, and measured the participants' blood pressure, while the study participants also wore fitness measuring devices to measure exercise-specific distance, duration, pace, energy expenditure, and steps, as well as wearing an ECG sensor with a chest strap to measure heart rate.

The results showed that all 3 types of aerobic exercise improved the cardiovascular profile in older adults when performed in acute bouts despite differences in duration and intensity – lowering their systolic blood pressure while walking and Nordic walking also led to a decrease in diastolic blood pressure.

However, despite the lower exercise intensity of golf compared with Nordic walking and walking, it was the longer duration and higher total energy expenditure involved in playing golf that seemed to positively affect lipid profile and glucose metabolism.

The study had some limitations such as the fact that it involved a small sample size and the accuracy of the fitness devices was debatable, while carrying out a study in a real-life environment does not allow for all factors to be controlled as they would be in a laboratory setting.

Also, the researchers only recruited golfers for the study because it was thought that non-golfers could not be expected to play a round of golf properly, while Nordic walking was seen as a new type of exercise for most participants, which may have led to poor technique, therefore decreasing the effectiveness of the Nordic walking activity.

However, the authors concluded: "Despite the lower exercise intensity of golf, the longer duration and higher energy expenditure appeared to have a more positive effect on lipid profile and glucose metabolism compared with Nordic walking and walking.

"These age-appropriate aerobic exercises can be recommended to healthy older adults as a form of health-enhancing physical activity to prevent cardiovascular diseases and can also be used as a treatment strategy to improve cardiometabolic health among those who already have a cardiovascular disease." ler

Source: *Kettinen J, Tikkanen H, Venojärvi M. Comparative effectiveness of playing golf to Nordic walking and walking on acute physiological effects on cardiometabolic markers in healthy older adults: a randomized crossover study. BMJ Open Sport & Exercise Medicine 2023;9:e001474. doi: 10.1136/bmjsem-2022-001474*

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HOSPITALIZATIONS AND HIP FRACTURES

In a study of 701 hip fracture patients (age >65 yrs), researchers from Beijing, China, found that those who underwent surgery within 2 days of admission (Early Surgery Group) had fewer perioperative challenges than those whose surgery was delayed. The Early Surgery Group (n=357, average age 80.1 yrs) had a significantly lower incidence of urinary tract infection (UTI; 19.6% vs 32.6%, $P < 0.001$), deep venous thrombosis (DVT; 9.8% vs 18.3%, $P < 0.001$), and pressure ulcer (3.4% vs 9.6%, $P < 0.001$) as well as a shorter surgical duration, less intraoperative blood loss (150 mL vs 200 mL), and a significantly shorter length of hospital stay (4 days [range 3-5] vs 5 days [range 4-7]; $P<0.001$). While the 6-month mortality rate was not significantly different, the readmission rate in the Delayed Surgery Group (n=344, average 79.6 yrs) was significantly higher than that in the Early Surgery Group 6 months after surgery (34 [9.5%] vs 56 [16.3%], $P = 0.008$). The authors concluded that early surgery can shorten the length of the postoperative hospitalization and bed rest for patients and reduce complications such as pulmonary infections, UTIs, and lower extremity DVT associated with bed rest.

Source: *Sun L, Wang C, Zhang M, Li X, Zhao B. The surgical timing and prognoses of elderly patients with hip fractures: a retrospective analysis. Clin Interv Aging. 2023;18:891-899. doi: 10.2147/CIA.S408903.*

EXERCISE, NUTRITION, AND MUSCLE OUTCOMES

As the population ages, sarcopenia becomes a greater challenge and opportunities for its prevention are critical to keeping older adults active and healthy and preventing a major public health burden. A new scoping review examined 13 studies that looked at home-based exercise and nutrition programs and their effect on muscle outcomes (mass, function, strength) among older adults. Among their many findings:

- Resistance training (RT) was more potent in helping maintain/improve muscle mass and strength, while multi-component programs improved muscle function.
    - o Two studies showed that RT 3 days per week can help enhance muscle mass.
- Providing detailed specific nutrition information on when, how, and how much food and/or supplements should be taken appeared to show improvements in muscle outcomes.
- While it has been established that dietary protein requirements are higher in older adults, it is well-known that most older adults do not meet these requirements. Routine testing for protein intake would help with sarcopenia studies moving forward.
    - o Recommendations for sarcopenia prevention and intervention for older adults vary from 1–1.5 g/kg/day of protein combined with regular exercise.
    - o One study that increased participants' protein intake to 1.2 g/kg/day showed improved muscle quality.
    - o Timing of the protein intake is also key. The International Society of Sports Nutrition (ISSN) recommends post-exercise high protein ingestion (immediately to 2 hours) to stimulate muscle growth; consuming 20–40 g of high-quality protein doses based on 0.25–0.40 g/kg body is ideal.
- Studies that showed improved muscle strength provided participants with home equipment to assist with the exercise regimen. (ler)

Source: *Sun L, Wang C, Zhang M, Li X, Zhao B. The surgical timing and prognoses of elderly patients with hip fractures: a retrospective analysis. Clin Interv Aging. 2023;18:891-899. doi: 10.2147/CIA.S408903.*

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DATA-DRIVEN BALANCE ASSESSMENTS

Evidence shows that that nearly 75% of people over age 70 have some type of balance disorder. Given the ongoing growth of the aging population, this represents a public health burden and threat to the healthcare system. Balance assessments play an important role in accurately diagnosing potential disorders, identifying fall risks, and developing treatment plans. Traditional balance assessments rely on clinician's judgments, which can be subjective. These authors looked at using equipment-based and digitalized assessment methods to eliminate subjective opinions from balance assessments. They combined 3D skeleton data from the Kinect system in 10 healthy recruits with deep convolutional neural networks (DCNN), a popular machine learning technology, and compared their findings with those of traditional assessments during walking from 300 sample cases. Their results suggest that 3D skeleton data and DCNN can be used for balance assessment with decent accuracy. The proposed method should be useful in early screening balance impaired people. It can partially replace commonly used balance measures and reduce the influence of subjective factors. (ler)

Source: *Ma X, Zeng B and Xing Y. Combining 3D skeleton data and deep convolutional neural network for balance assessment during walking. Front. Bioeng. Biotechnol. 11:1191868. doi: 10.3389/fbioe.2023.1191868*

SHARED MEDICAL APPOINTMENT FOR FALL RISK ASSESSMENT

Falls are a leading cause of morbidity and mortality in the aging population yet only a small percentage of older adults report being asked about falls or their risk for falls. The Centers for Disease Control and Prevention initiated the STopping Elderly Accidents, Deaths and Injuries (STEADI) toolkit more than 10 years ago, but provider uptake has been slow due to provider time limitations. Research has shown that promising outcomes from shared medical appointments (SMAs), particularly related to patient education and screening for fall risk reduction, and ultimately in reducing falls in this population. Researchers at the University of California, San Diego, wanted to establish an SMA workflow to comprehensively screen and evaluate fall risk. Their model included referring patients to the SMA with scheduling per their preference virtually or in-person. Patients then

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Circle "Yes" or "No" for each statement below			Why it matters
Yes (2)	No (0)	I have fallen in the past year.	People who have fallen once are likely to fall again.
Yes (2)	No (0)	I use or have been advised to use a cane or walker to get around safely.	People who have been advised to use a cane or walker may already be more likely to fall.
Yes (1)	No (0)	Sometimes I feel unsteady when I am walking.	Unsteadiness or needing support while walking are signs of poor balance.
Yes (1)	No (0)	I steady myself by holding onto furniture when walking at home.	This is also a sign of poor balance.
Yes (1)	No (0)	I am worried about falling.	People who are worried about falling are more likely to fall.
Yes (1)	No (0)	I need to push with my hands to stand up from a chair.	This is a sign of weak leg muscles, a major reason for falling.
Yes (1)	No (0)	I have some trouble stepping up onto a curb.	This is also a sign of weak leg muscles.
Yes (1)	No (0)	I often have to rush to the toilet.	Rushing to the bathroom, especially at night, increases your chance of falling.
Yes (1)	No (0)	I have lost some feeling in my feet.	Numbness in your feet can cause stumbles and lead to falls.
Yes (1)	No (0)	I take medicine that sometimes makes me feel light-headed or more tired than usual.	Side effects from medicines can sometimes increase your chance of falling.
Yes (1)	No (0)	I take medicine to help me sleep or improve my mood.	These medicines can sometimes increase your chance of falling.
Yes (1)	No (0)	I often feel sad or depressed.	Symptoms of depression, such as not feeling well or feeling slowed down, are linked to falls.
Total _____		Add up the number of points for each "yes" answer. If you scored 4 points or more, you may be at risk for falling. Discuss this brochure with your doctor.	

To check your risk online, visit: www.bit.ly/3o4RiW8

This checklist was developed by the Greater Los Angeles VA Geriatric Research Education Clinical Center and affiliates and is a validated fall risk self-assessment tool (Rubenstein et al. J Safety Res; 2011: 42(6)493-499). Adapted with permission of the authors.

Continued on page 18

Continued from page 17

attended a nurse visit for appropriate fall risk related screening, followed by the SMA with 2 physicians for review of medical history, fall screening results, and implementation of fall reduction strategies.

Overall, 52 patients were seen/assessed between November 2021 and February 2023 with SMAs ranging from 3 to 5 patients with an average age of 77 (=/− 6.7). Questionnaire self-reported risk factors (from CDC's Stay Independent brochure, Table, page 17), self-reported strength, and polypharmacy were associated with objective markers of increased fall risk. Follow up survey results found the clinically integrated model was well accepted by patients. The authors concluded that falls prevention SMAs can be effective.

Source: *Moran R, Ramirez M, Wood G, Hofflich H, Wing D, Nichols J. Shared-medical appoint for screening and risk assessment for fall prevention. Gerontol Geriatr Med. 2023;9:1-6. https://doi.org/10.1177/23337214231186460*

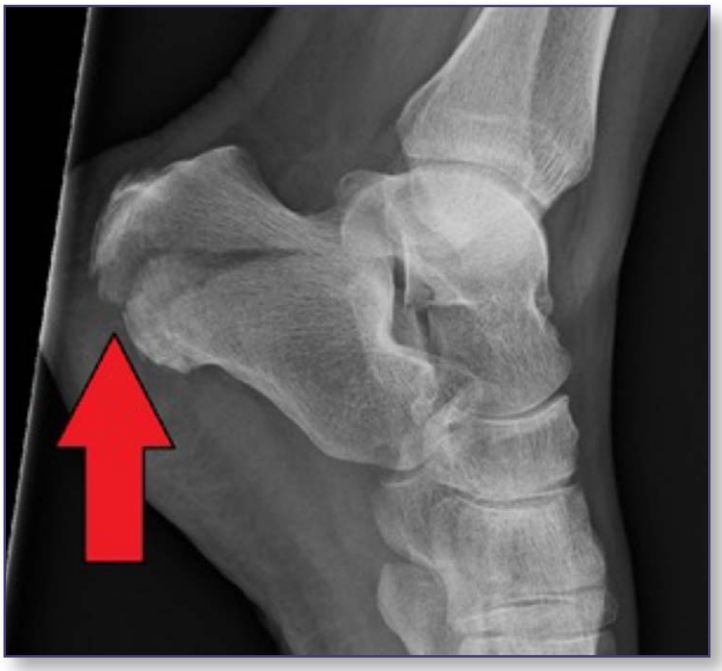
CALCANEAL FRACTURES

Calcaneal fractures account for 60% of tarsal fractures, and intra-articular fractures account for up to 75% of those. Displaced intra-articular calcaneal fractures are often accompanied by long-term sequelae, permanent disability and other adverse conditions, particularly wound complications such as dehiscence, heel necrosis, hematoma; and infection, and 6.1% of those with infections subsequently developed deep infection and osteomyelitis. Thus, predicting the prognosis of calcaneal fractures can effectively improve post-op recovery and reduce pain in patients.

The authors of this new study developed and validated a clinical predictive model to predict the risk of postoperative recovery in calcaneal fractures. According to the nomogram, weightbearing time was the most important predictor, followed by age, postoperative infection, gender, and waiting time for surgery. Their findings showed that:

- Weight-bearing exercise within 3 months after operation can improve fracture recovery. They suggest that evidence-based weight-bearing rehabilitation exercises should be carried out in the early stage of postoperative recovery customized to individual patients.
- Female and older patients over 60 years were at higher risk for poor fracture recovery due to age-related bone loss.
- Timely treatment of incision site infection could prevent skin flap necrosis which, if not treated in time, can further develop into calcaneal osteomyelitis, or case delayed union or malunion.
- Waiting longer than 14 days between injury and surgery could increase the risk of wound infection.
- Injury mechanism and fracture type were not related to the prognosis score.

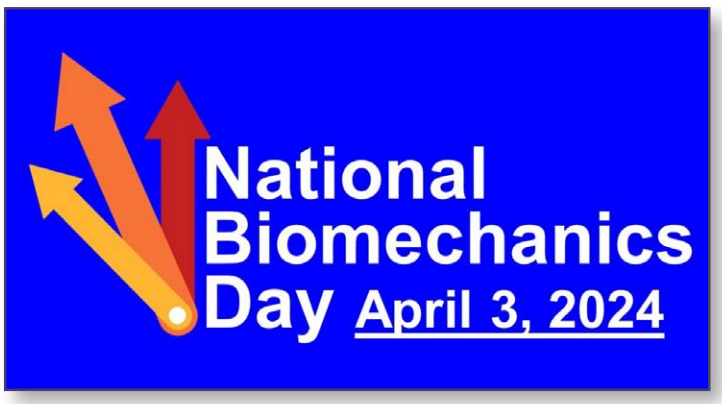
The authors did note that the small incision for calcaneal surgery invented by Academician Zhang significantly reduces injury to the bone and soft tissue through accurate minimally invasive screw implantation.



However, in their study, there was no significant difference in postoperative recovery of calcaneal fractures treated with small incisions compared with other types of incisions.

The authors write in their conclusion: According to the risk prediction model, the postoperative prognosis of calcaneal fracture can be predicted, which can provide guidance for orthopedic surgeons to make targeted preoperative examinations, surgical plans and rehabilitation training.

Source: *Li W, Wang Y, Zhang Z, et al. A risk prediction model for postoperative recovery of closed calcaneal fracture: a retrospective study. J Orthop Surg Res. 2023;18:612. https://doi.org/10.1186/s13018-023-04087-8*



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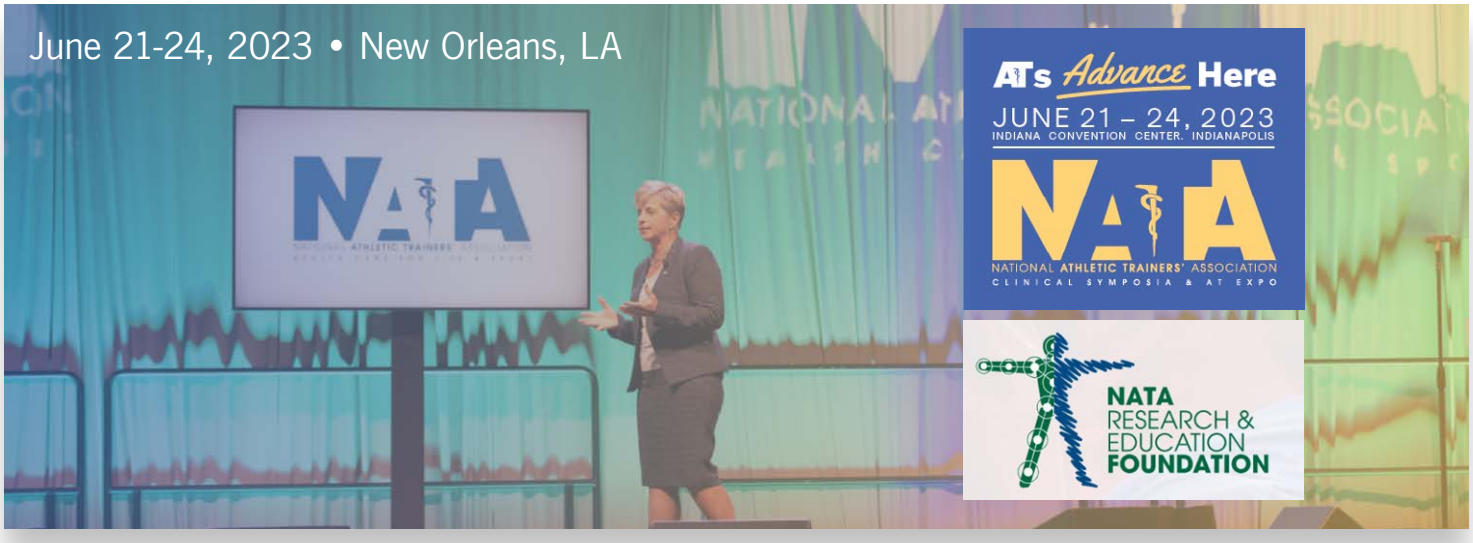

Meeting Highlights II from the National Athletic Trainers' Association

Lower Extremity Review thanks the National Athletic Trainers' Association, the NATA Research & Education Foundation, the Journal of Athletic Training, and the authors for granting reuse permissions for this information.

NEUROCOGNITIVE HOP PERFORMANCE AND CHRONIC ANKLE INSTABILITY

This study aimed to compare the relationship between self-reported ankle disability and neurocognitive hop performance among healthy controls, ankle sprain copers, and individuals with chronic ankle instability (CAI). The researchers hypothesized that there would be differences in hop performance among the three groups and a negative correlation between self-reported ankle disability and hop performance in the CAI group.

The participants completed the Choice-Reaction Hop Test (CRHT), which involved hopping on a mat indicated by a flashing light. The results showed no significant difference in hop performance among the three groups, but there was a large correlation between self-reported ankle disability and hop performance in the CAI group.

The researchers concluded that the CRHT may be a useful test to assess neurocognitive hop performance in individuals with CAI and assist clinicians in making clinical decisions for these patients.

Source: *Choi JY, Vogel CM, Remski LE, Knarr BA, Rosen AB. The Relationship Between Neurocognitive Hop Performance and Self-Reported Ankle Function Among Chronic Ankle Instability Participants, Ankle Sprain Copers and Healthy Controls. J Athl Train. 2023;58(6S):96.*

INJURY & TREATMENT CHARACTERISTICS IN MIDDLE SCHOOL ATHLETES

These researchers analyzed injury and treatment patterns among middle school-aged athletes receiving care from athletic trainers who were members of the Athletic Training Practice-Based Research Network (AT-PBRN). The study identified football, basketball, and soccer as the sports with the highest frequency of injuries, with concussions and ankle sprains/strains being the most common diagnoses. The most commonly used treatments included hot/cold packs, therapeutic exercise, and athletic trainer evaluation.

A total of 1,011 sports-related injuries were documented during the study period for middle school-aged athletes (age in years: 10=45, 11=135, 12=273, 13=558; sex: male=503, female=506, declined to answer=2). Football (17.7%, n=179), basketball (17.6%, n=178), and soccer (14.9%, n=151) reported the highest number of injuries. Ankle (17.1%, n=173), knee (16.5%, n=167), and head (14.1%, n=143) were the most common injury locations. Concussion (ICD-10=S06.0X0XA; 12.3%, n=124), ankle strain/sprain (ICD-10=S93.409A; 9.4%, n=95), and sprain/strain of the thigh/hip/groin (ICD-10=S73.109A; 7.4%, n=75) were the most reported diagnoses.

A total of 3,870 treatments were recorded during the study period, with hot/cold packs (CPT=97010; 17.2%, n=665), therapeutic exercise (CPT=97110; 15.4%, n=595), athletic trainer re-evaluation (CPT=97006; 12.9%, n=501), athletic trainer evaluation (CPT=97005; 11.8%, n=456), and manual therapy (CPT=97140; 9.3%, n=358) being the most recorded services. Patients attended a median of 2 visits (IQR=1-4) with a median 2 procedures per visit (IQR=1-2).

These findings offer important insights for athletic trainers and parents/guardians in managing the health of middle school-aged athletes.

Source: *McCarthy M, Sigmon T, Marshall AN, Lam KC, Koldenhoven RM. Injury and Treatment Characteristics of Middle School-Aged Patients Under the Care of Athletic Trainers From 2010-2022: A Report From the Athletic Training Practice-Based Research Network. J Athl Train. 2023;58(6S):72.*

Continued on page 23

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CONTRIBUTING FACTORS TO PERSISTENT PAIN AFTER LAS

This study investigated factors that may contribute to the development of persistent pain 6 months after a lateral ankle sprain (LAS). The findings indicated that experiencing pain at the time of returning to activity and being able to bear full weight at the time of study enrollment (up to 7 days after event) were associated with a higher likelihood of persistent pain 6 months post-sprain.

Current clinical practice guidelines for ankle sprain recommend progressive weight-bearing with support during the early phase of recovery and supervised rehabilitation. Interestingly, supervised rehabilitation was not identified in this study as a preventative factor against developing persistent pain despite almost 62% of participants seeking such care. Instead, these results suggest full weight-bearing status at the time of enrollment and ongoing pain at the time of return to activity were associated with persistent pain 6 months after an ankle sprain. These results provide preliminary support for the need to re-examine recommendations for the early phases of recovery post-injury and potential reasons why individuals are returning to activity with ongoing symptoms (eg, pain). ler

Source: *Kosik KB, McCann RS, Slone S, Orhnberger E, Gribble PA. Protective Factors and Risk Factors for Persistent Pain 6-Months After Lateral Ankle Sprain. J Athl Train. 2023;58(6S):110.*

POST-LAS WALKING BOOT USE REDUCES CAI

Early Career Winner

This study investigated the effectiveness of care strategies and patient-reported outcome scores in predicting the development of chronic ankle instability (CAI) after an acute lateral ankle sprain (LAS). This study enrolled 51 community participants within 1 week of LAS (average age 21.5 yrs). Participants answered surveys about their use of assistive weight-bearing devices (crutches, walking boot) following injury and also included several PRO questionnaires: Identification of Functional Ankle Instability (IdFAI), Foot and Ankle Disability Index (FADI), Godin Leisure-Time Exercise questionnaire, and Short Form-8 (SF8).

Based on 12-month follow-up IdFAI scores, 42 (82.5%) participants were classified as having CAI and 9 (17.5%) were classified as copers (COP). Chi-square analysis revealed a higher frequency of walking boot use in COP (55%) versus CAI (21%) ($\chi2=4.33$, $P=0.04$). At the 6-month interval, the CAI group displayed lower SF8 physical component (CAI: 55.7±5.6 vs COP: 59.7±2.5, $P<0.01$, d=0.88 [0.09,1.66]) and higher IdFAI (CAI: 21.7±6.3 vs COP: 15.9±8.2, $P=0.03$, d=0.76 [-0.02,1.54]) scores compared to COP. Logistic regression analysis revealed the combination of walking boot use and 6-month IdFAI and SF8 physical component scores were significant predictors of CAI classification at 12-months ($\chi2=13.13$, $P<0.01$, R2=0.41). ROC curve analysis further showed the combination of these variables had strong predictive value for CAI classification at 12-months (AUROC=0.87 [0.76,0.99], $P<0.01$).

The findings suggest that using a walking boot immediately after an acute LAS and having favorable patient-reported outcome scores at a 6-month follow-up can reduce the likelihood of developing CAI at a 12-month follow-up. The study highlights the importance of temporary immobilization and monitoring patient perceptions beyond return-to-activity for preventing CAI. ler

Source: *McCann RS, Kosik KB, Ohrnberger E, Gribble PA. Patient-Reported Outcomes and Walking Boot Use Following an Acute Lateral Ankle Sprain Predict Chronic Ankle Instability. J Athl Train. 2023;58(6S):112.*

MUSCLE CONTRIBUTIONS ALTERED DURING DROP VERTICAL JUMPS IN CAI

This study examined the joint loads and muscle forces during landing in individuals with chronic ankle instability (CAI) compared to those without CAI. The findings revealed that individuals with CAI had lower ankle joint loads and reduced muscle force contributions, particularly from the soleus muscle. These altered loading patterns during landing may increase the risk of ankle joint degeneration in CAI patients.

Chronic ankle instability (CAI) affects joint loads during landing by altering muscle forces and subsequently reducing ankle joint loads in all directions. Individuals with CAI exhibit lower compressive, posterior, and lateral ankle joint loads compared to uninjured controls while landing.

During landing for individuals with CAI, the muscle force contributions that are reduced include the medial gastrocnemius and soleus muscles during the 1st peak in the compressive joint contact force (JCF), as well as the soleus muscle during the 2nd peak in the posterior and lateral JCF.

The altered loading patterns observed in CAI patients during landing may have potential implications for ankle joint degeneration. These

Continued on page 25

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altered loading patterns, characterized by lower compressive, posterior, and lateral ankle joint loads, may contribute to abnormal stress distribution within the joint and potentially accelerate the degenerative process.

Source: *Jang J, Pietrosimone BG, Lin FC, Franz,JR, Wikstrom EA. Muscle Contributions and Ankle Joint Contact Forces Are Altered During Drop Vertical Jumps Landings in Patients With Chronic Ankle Instability. J Athl Train. 2023;58(6S):115.*

THE IMPACT OF SUPERVISED REHABILITATION AND RE-INJURY OF LAS

There is an increased risk for re-injury throughout the first 12 months after an acute lateral ankle sprain (LAS). Prior research has demonstrated that those with ankle sprain history have decreased Health Related Quality of Life (HRQoL). The purpose of this study is to determine the impact of supervised rehabilitation on HRQoL throughout the first 12 months post-injury.

Fifty volunteers (M:18; F:32) enrolled in a survey-based study within 1 week of the incident LAS and no associated fracture or surgery. Participants were classified into 2 groups: those who self-reported they had participated in supervised physical rehabilitation (SUP; n=31), or those who did not (NoSUP; n=19). At the 12-month follow up, participants completed an online survey that included the Short Form-8 (SF-8) questionnaire with a question asking if they had had a recurrent LAS in the past year on the affected side. Ten participants reported an additional LAS. Independent sample t-tests were used to compare the SF-8 scores of General Health, Physical Component, and Mental Component between 1) SUP and NoSUP groups, and 2) those who did or did not report or an additional LAS.

There were no significant differences between the SUP and NoSUP groups in General Health (P=0.31), Physical Component (P=0.15) or Mental Component (P=0.37) scores. Those that reported an additional ankle sprain had significantly lower General Health (LAS:50.89±10.99; No LAS:58.29±7.22; P<0.01) and Physical Component Scores (LAS:52.16±8.55; No LAS:56.41±4.96; P=0.02); but there were no differences in Mental Component scores (P=0.28).

Those with an additional LAS within 12 months of an acute injury report worse general health and physical HRQoL scores, but participation in supervised rehabilitation did not seem to affect SF-8 scores. Further research is needed to understand the role of formalized rehabilitation for LAS and how to optimize rehabilitation protocols to improve comprehensive outcomes. ler

Source: *Ohrnberger E, Kosik KB, McCann RS, Gribble PA. The Impact of Supervised Rehabilitation and Re-Injury of Lateral Ankle Sprains on Health-Related Quality of Life in the General Population. J Athl Train. 2023;58(6S):156.*

LAS HEALTHCARE UTILIZATION BY D-I COLLEGIATE ATHLETES

Lateral ankle sprain (LAS) is a common injury with a high recurrence rate. Potential inequities in care provided may contribute to recurrence. The purpose of this study was to describe LAS classified as 'recurrent' in NCAA Division I athletes across select gender comparable sports, assessing for potential differences in occurrence and healthcare utilization by gender, race/ ethnicity, and recurrence type.

This descriptive epidemiology design used de-identified medical records from 14,030 student athletes from a single conference who reported injuries from August 2016-November 2021. Sport-related LAS were stratified by recurrence type (i.e. new sprain, first recurrence, multiple recurrence). Frequencies by gender, race/ethnicity, and gender comparable sport (i.e. baseball/softball, basketball, and cross country/track) were calculated. Athletic training services (ATS) provided and whether a physician-level encounter (PE) occurred were noted for each LAS.

Of the 2,862 ankle sprains reported overall, 2,168 (75.8%) were LAS. Of those, 334 occurred in gender comparable sports and reported race/ethnicity. Of the 334 LAS analyzed, 72.2% were new sprains (n=241), 13.5% (n=45) were first recurrence, and 14.4% (n=48) were multiple recurrence. Within gender comparable sports, there were no significant associations between recurrence type and gender (X2=0.04, P=0.98) or race/ethnicity (X2=5.52, P=0.24). When assessing the intersection of gender and race/ethnicity, recurrence type was not associated with race/ethnicity when assessing men or women separately (X2=8.80, P=0.07, X2=1.75, P=0.78). ATS were most frequent for new sprains (n=2,013/2,735, 73.6%). PE were most frequent for new sprains (n=67/86, 77.9%) with no association between gender and PE (X2=0.24, P=0.89).

Approximately 28% of LAS were classified as recurrent in gender comparable sports. Though LAS recurrence rate was relatively high, there was no evidence of inequities in healthcare utilization or access in these collegiate student-athletes. ler

Source: *Brown CN, Bovbjerg VE, Johnson ST, Norcross MF. Lateral Ankle Sprain Recurrence and Healthcare Utilization by Gender, Race/ Ethnicity, and Sport in Division I Collegiate Athletes. J Athl Train. 2023;58(6S):210.*

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Therapeutic Benefits of Ankle-Foot Prostheses

By Elke Lathouwers, María Alejandra Díaz, Alexandre Maricot, Bruno Tassignon, Claire Cherelle, Pierre Cherelle, Romain Meeusen, and Kevin De Pauw

A better understanding of the therapeutic benefits of performing daily activities with passive, quasi-passive, and active ankle-foot prostheses in people with a lower limb amputation can help gauge the impact of these prostheses on quality of life.

After lower limb loss, assistive devices are a fundamental part of rehabilitation with the aim to restore daily activities and improve quality of life. A prosthesis is generally favored among assistive devices as it enables a person to carry out daily activities as naturally as possible. The current evolution in prosthetic development is shifting from developing passive prostheses to quasi-passive and active prostheses in order to minimize prosthetic-related adverse events affecting quality of life. It also helps to enhance self-esteem as it ensures that people diverge as little as possible from the physical appearance of able-bodied individuals.

Lower limb prostheses also complicate the performance of daily activities. This performance is affected by several factors, including the type of prosthesis, prosthetic embodiment, the level and cause of the amputation, degree of mobility, and presence of comorbidities. These factors complicate tasks such as positioning the foot in space, walking horizontally, going up and down ramps and stairs, crossing obstacles, walking on slippery floors, and transitioning between activities. For instance, it has been well-established that walking with a lower limb prosthesis results in aberrations in gait kinetic and spatiotemporal parameters compared to able-bodied walking. Additionally, prosthetic use may cause falls and secondary injuries, including low back pain and osteoarthritis of the healthy knee and hip, entailing high medical costs and diminishing quality of life.

Despite that enhancing the quality of life of people with a lower limb amputation is critical in prosthetic development and rehabilitation, no overview is available concerning the impact of passive, quasi-passive, and active ankle-foot prostheses. With that objective in mind, the study authors conducted a systematic review of the therapeutic benefits of performing daily activities with passive, quasi-passive, and active ankle-foot prostheses in people with a lower limb amputation.

Methods

A search of the Pubmed, Web of Science, Scopus, and Pedro databases was conducted. Only English-written randomized controlled trials, cross-sectional, cross-over, and cohort studies were included when the population comprised adults with a unilateral transfemoral or transtibial amputation, wearing passive, quasi-passive, or active ankle-foot prostheses. The intervention and outcome measures had to include any aspect of quality of life assessed while performing daily activities. The participants' characteristics, type of prosthesis, intervention, outcome, and main results were synthesized.

This article has been excerpted from "Therapeutic benefits of lower limb prostheses: a systematic review," J NeuroEngineering Rehabil. 2023;20:4. https://doi.org/10.1186/s12984-023-01128-5. Editing has occurred, including the renumbering or removal of tables and figures, and references have been removed for brevity.

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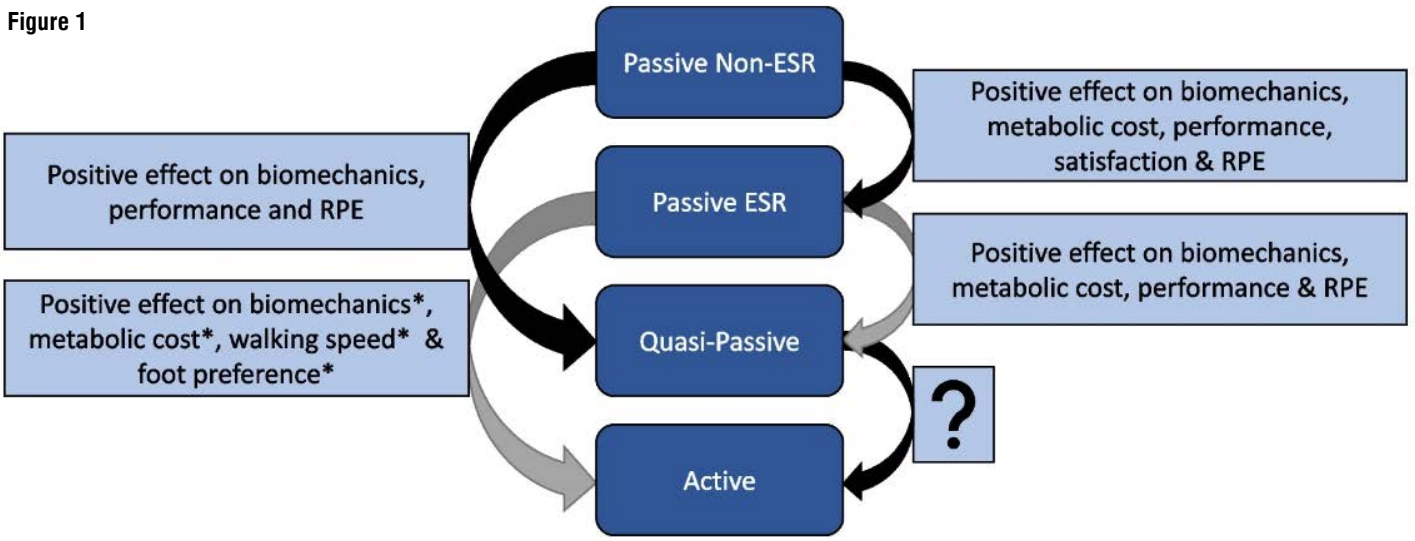
Figure 1



Short-term therapeutic benefits of passive, quasi-passive and active ankle–foot prostheses in people with a unilateral transtibial and transfemoral amputation. The arrows indicate the effect of switching from one type of prosthesis to another. For example, switching from passive non-ESR to quasi-passive prostheses entails positive effects on biomechanics, performance and RPE. ESR: energy-storing and release; RPE: rating of perceived exertion; ?: currently unknown, to be investigated; *effect based on studies only including people with a transtibial amputation

Results

The study authors identified 4,281 records and included 34 studies in total. The prosthetic evaluation was mainly conducted through level walking tasks. All studies investigated the short-term effects of performing daily activities with prosthetic ankle-foot devices, and none of the studies examined long-term effects. Biomechanical outcome measures were most frequently gathered, and to a lesser extent physiological, performance, and subjective measures were gathered. Results indicate that quasi-passive and active prostheses are favored over passive prostheses based on biomechanical, physiological, performance, and subjective measures in the short-term. All studies had a moderate or high risk of bias.

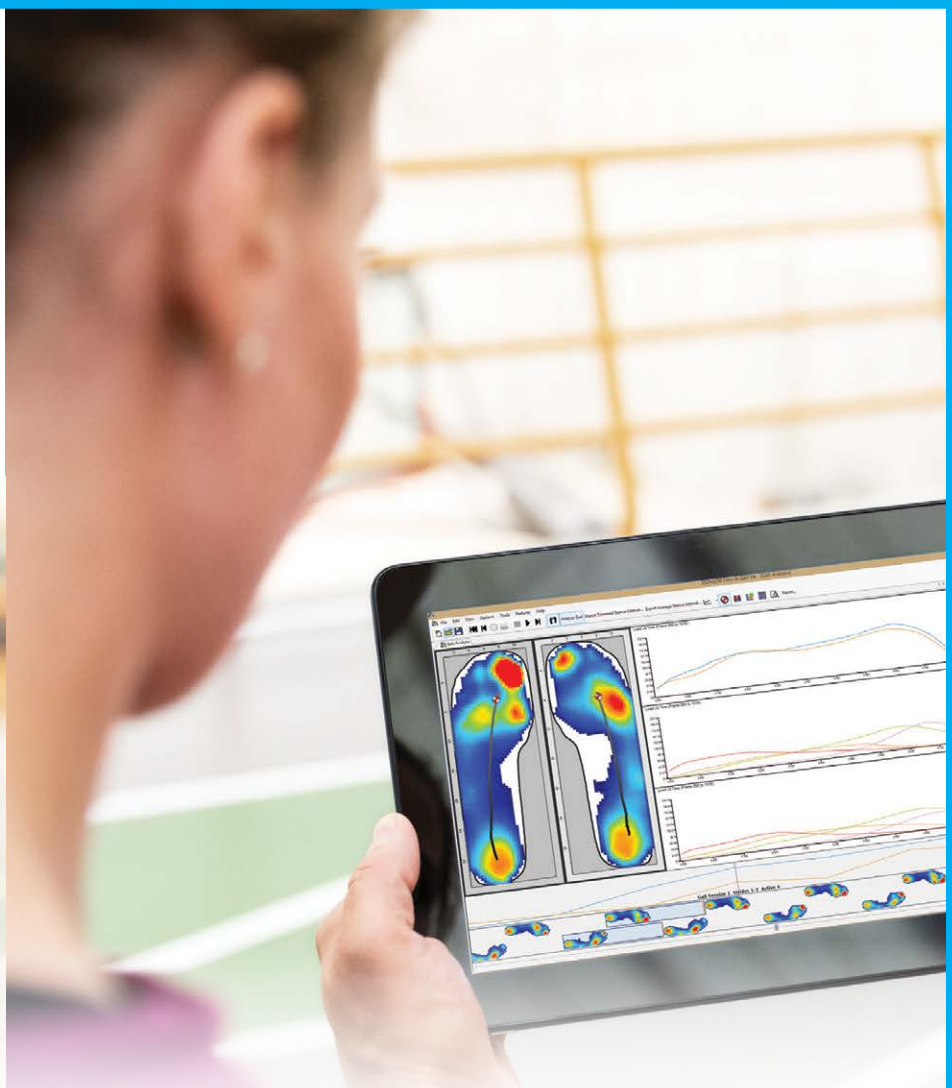
Discussion

The purpose of this study was to systematically review the therapeutic benefits of performing daily activities with passive, quasi-passive and active ankle-foot prostheses in people with a unilateral lower limb amputation. Remarkably, no studies investigated the long-term therapeutic benefits.

Figure 1 captures the short-term therapeutic benefits of passive, quasi-passive, and active prostheses. This figure shows the domains in which benefits were found. It was not possible to provide such an overview at the outcome measure level due to high heterogeneity. Overall, the numerous outcome measures per study yielded positive results on biomechanical, physiological, performance-related, or subjective outcomes for the more advanced prostheses, implying therapeutic benefits for the individuals walking with them, though all studies also identified no or unfavorable effects. The technological innovations contribute to improving the quality of life in the short-term when people with lower limb amputations switch the conventional passive cushion foot for a more advanced prosthesis (ie, the passive energy-storing release feet, the surface-adaptive quasi-passive feet, the active feet generating an external force through an actuator). However, comparisons between active prostheses and quasi-passive devices have not yet been conducted.

Among the included studies, quality of life has been evaluated using biomechanical, physiological, performance-related, or subjective measures. The biomechanical and physiological dimensions of quality of life have been assessed during level and slope walking in 94% of the included studies, while only 29% included the subjective dimension. In general, gait efficiency and efficacy improved in parallel with technological advances, though gait asymmetries remained. Further in-depth discussion of these parameters is not feasible due to the heterogeneity in outcome measure among the biomechanical and physiological parameters. Nevertheless, it is the ultimate goal of prosthetic development to strive toward the most efficient gait patterns by seeking complete gait symmetry and matching the gait patterns as closely as possible to those of able-bodied individuals. Furthermore, the limited data on the subjective dimension of quality of life revealed that the perceived effort and satisfaction increased in line with the advancement of the devices. The limited use of subjective measures can be attributed to the prohibitive cost of most active and quasi-passive devices for a subset of individuals. This factor might introduce a confounding variable in the data affecting subjective feedback. Conversely, these paywalls will not affect the biomechanical or physiological data. Nevertheless, subjective measures (eg, perceived effort, satisfaction, feedback on the noise of motors in active prostheses) should be more prominent in prosthetic evaluations, as they are crucial to assessing the quality of life.

Continued on page 31



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Due to its biomechanical focus, the prosthetic evaluation primarily targets aberrated movement patterns that can be remedied in the short term by a prosthesis. However, movement patterns are orchestrated by the intertwining between biomechanical factors and the human brain. This entails that the brain plays a vital role in the organization and performance of human gait. Magnetic resonance imaging revealed that amputation causes thinning of the premotor cortex and visual-motor area combined with a decrease in white matter integrity in the premotor area contralateral to the amputation and at a bilateral connection between both premotor cortices. These changes interfere with movement planning or coordinating eye movements in relation to limbs and lead to decreased perception–action coupling. Additionally, amputation causes changes in limb representation in the primary motor cortex and somatosensory cortex, and causes decreased connectivity between many brain areas, including the primary motor cortex, primary somatosensory cortex, basal ganglia, thalamus, and cerebellum. These changes in connectivity translate toward reduced motor control and balance and potentially lead to falls. Remarkably, only a single study examining the effect on brain functioning across prosthetic ankle-foot prostheses has been included in this review. Unravelling neuroplasticity in relation to the type of prosthesis may provide a new understanding of the effects of prostheses to improve the quality of life in people with a lower limb amputation.

A conceivable approach to account for the brain's influence is through dual tasks, conditional on adequate familiarization. Dual tasks involve the concurrent performance of 2 tasks and are regarded as a measurement of cognitive-motor capacity as they require executive function and attentional demand. Their performance usually results in decreased mobility and deteriorated gait patterns leading to increment falls. Out of the included articles in this review, only 1 investigated the difference between passive and quasi-passive prostheses during the performance of a dual-task during treadmill walking. That study found that only in individuals with a transfemoral amputation attention demands (reaction times and accuracy) increased during walking with the quasi-passive prosthesis compared to the current prosthesis and able-bodied individuals. Lack of familiarization time to habituate to the new prosthetic device may have influenced these results. As discussed earlier, the negative implications of performing dual-tasks are attributable to cognitive demands associated with prosthetic use, balance and gait disturbances, and brain adaptations. Combined with the fact that dual-tasks represent daily activities, the recommendation is to include dual-task paradigms in the evaluation process of prostheses.

Due to its biomechanical focus, the prosthetic evaluation primarily targets aberrated movement patterns that can be remedied in the short term by a prosthesis.

The design, development, and evaluation of prosthetic devices is an iterative process requiring high cross-disciplinary collaboration between multiple research branches. This review reveals that the current emphasis in prosthetic evaluation has been placed on comparing ankle-foot prostheses without long-term evaluation. Since none of the included studies investigated the long-term benefits of comparing different ankle-foot prostheses, the study authors stated that they cannot make any substantiated statements about the association between the onset of secondary injuries and the use of different types of prostheses solely based on studies conducted at a single point in time. Furthermore, it should be emphasized that the included studies mainly involved people with a transtibial amputation. In contrast, only 6 of the included studies involved people with a transfemoral amputation, limiting the results' generalizability within the prosthetic population. Also, the majority of the studies (94%) are based upon biomechanical and physiological findings during the performance of walking tasks, except for 2, which used performance and subjective measures. Another concern relates to the overall high risk of bias. The high risk of bias can be attributed to the lack of randomization, the inability to blind participants to the prosthetic condition, and the lack of reporting protocol deviations. Specifically, the lack of randomization and inability to blind participants are essentially inherent to prosthetic research. Taken all of the aforementioned elements into account, heterogeneity of the outcome measures combined with small sample sizes, limited familiarization time, and the high risk of bias of the included studies do not allow robust conclusions to be made. Therefore, the recommendation is to perform adequate sampled studies with a limited number of outcome measures and ample familiarization time evaluating a prosthetic device during daily activities. Secondly, the recommendation is shifting the emphasis toward the psychosocial dimension of quality of life through questionnaires finding a suitable poise between objective and subjective measures to obtain a thorough insight into the benefits of prosthetic devices. Lastly, the study authors advise conducting prospective studies assessing the benefits of passive, quasi-passive, and active prostheses in the longer term.

Conclusion

This review evaluated the differences in the quality of life between passive, quasi-passive, and active prostheses for people with a lower limb amputation using biomechanical, physiological, performance and subjective measures. Compared to passive ankle-foot prostheses, quasi-passive and active prostheses improve quality of life. Although short-term therapeutic benefits have been established favoring more advanced prostheses, outcome measures' discrepancies prevail, the brain's influence on prosthetic functioning is insufficiently studied, and the long-term benefits remain unknown. Investigating these aspects may improve the quality of life of people with a lower limb amputation.

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Kickboxing-related Lower Extremity Injuries Treated at United States Emergency Departments

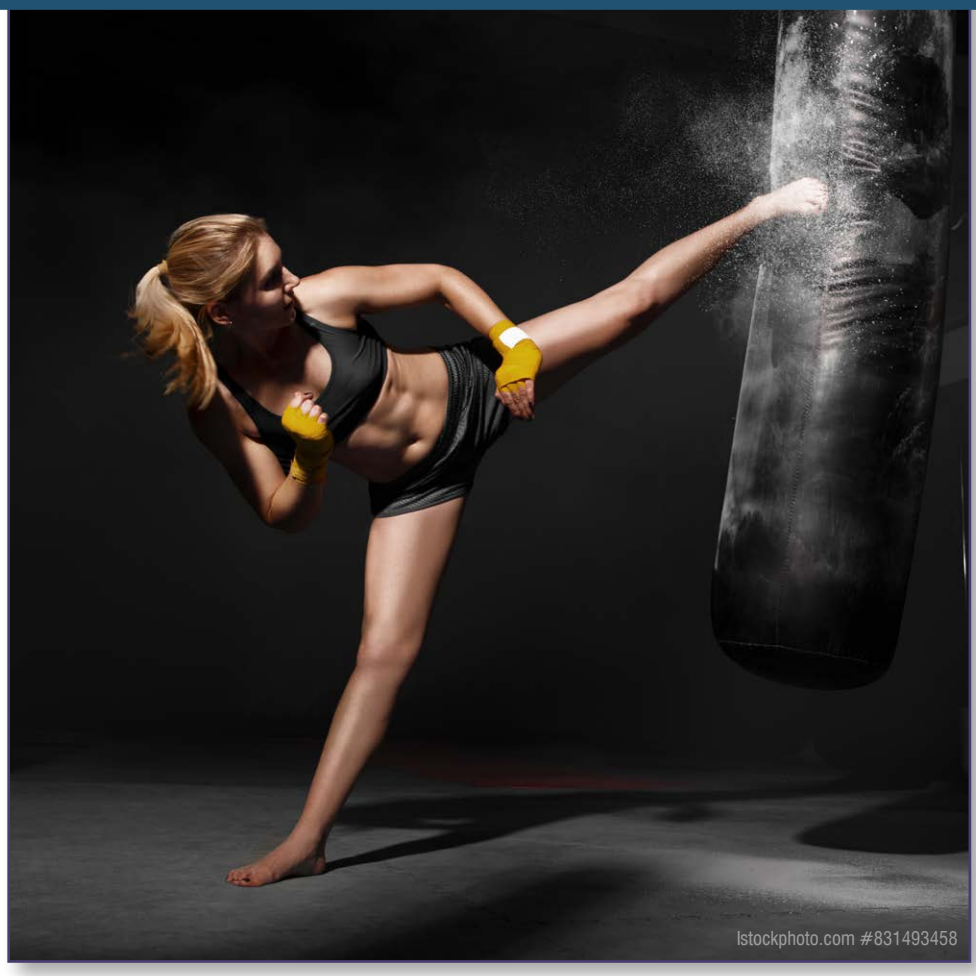
By Mathias B. Forrester, BS

Background: Kickboxing is a popular full-contact sport that allows both punching and kicking from a standing position. Kickboxing may be performed in sports competitions or as a form of exercise. Injuries, including to the lower extremity, may occur in relation to kickboxing. The objective of this study was to describe kickboxing-related lower extremity injuries treated at United States (US) hospital emergency departments (EDs).

Methods: Kickboxing-related lower extremity injuries during 2000-2022 were identified using the National Electronic Injury Surveillance System (NEISS), a database of consumer product-related injuries treated at a representative sample of US hospital EDs. Cases reported to the NEISS can be used to calculate national injury estimates. The distribution of kickboxing-related lower extremity injuries was determined for patient demographics, injury circumstances, and management.

Results: Of an estimated 69,832 total kickboxing-related injuries, 34,922 (50.0%) involved the lower extremity. Of these lower extremity injuries, the affected body part was 31.6% foot, 21.8% ankle, 21.2% knee, 12.6% lower leg, 11.2% toe, and 1.6% upper leg. The most common injuries were 42.0% strain or sprain, 22.9% contusion or abrasion, and 14.3% fracture. The age distribution was 3.6% 0-12 years, 16.2% 13-19 years, 35.7% 20-29 years, 24.7% 30-39 years, 12.0% 40-49 years, and 7.7% 50 years or older; 51.9% of the patients were male and 48.1% female.

Conclusion: Half of all kickboxing-related injuries involved the lower extremity. The majority of patients with lower extremity injuries were age 20-39 years and evenly divided between males and females. The most commonly reported lower extremity injuries were strain or sprain, contusion or abrasion, and fracture, and the most frequently affected parts of the lower extremity were the foot, ankle, and knee.



Kickboxing, a full-contact sport, is a type of boxing that allows both punching and kicking from a standing position. Participants of the sport may use mouth guards, hand wraps, boxing gloves, groin guards, and shin pads; the feet may be covered in kick boots (foot pads) or left bare. Kickboxing may be practiced for competition, general exercise, or self-defense. There are a variety of styles of kickboxing which differ in rules and in which actions are allowed or prohibited.[1-3] It has been reported that 6.69 million people participated in cardio kickboxing in 2017, with the number of participants increasing over time.[4]

Injuries may occur in relation to kickboxing during competition as well as during general exercise. All parts of the body may be injured, including the lower extremity. Commonly reported kickboxing injuries include lacerations, contusions, fractures, strains and sprains, and concussions.[1-3,5-8] The intent of this study was to describe kickboxing-related lower extremity injuries reported to United States (US) hospital emergency departments (EDs).

Methods

The data source for this retrospective epidemiologic study was the National Electronic Injury Surveillance System (NEISS) website (https://www.cpsc.gov/cgibin/NEISSQuery/home.aspx). Operated by the US Consumer Product Safety Commission (CPSC), the NEISS collects data on consumer product-related injuries from the EDs of a stratified random sample of 100 hospitals from the more than 5,000 hospitals in the US. The random sample is stratified by hospi-

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Table 1. Affected body part and diagnosis of kickboxing-related lower extremity injuries treated in United States emergency departments, National Electronic Injury Surveillance System, 2000-2022

Variable	No.		Est.		
	No.	%	No.	%	95% CI
Body part affected					
Foot	243	29.5	11,026	31.6	8,152-13,899
Ankle	178	21.6	7,597	21.8	5,431-9,763
Knee	193	23.4	7,420	21.2	5,292-9,549
Lower leg	100	12.1	4,402	12.6	2,946-5,858
Toe	95	11.5	3,909	11.2	2,570-5,249
Upper leg	16	1.9	567	1.6	-
Type of injury					
Strain or sprain	360	43.6	14,666	42.0	11,080-18,252
Contusion or abrasion	171	20.7	7,987	22.9	5,738-10,236
Fracture	119	14.4	5,010	14.3	3,413-6,606
Dislocation	15	1.8	799	2.3	-
Laceration	10	1.2	415	1.2	-
Hematoma	3	0.4	164	0.5	-
Dermatitis	2	0.2	75	0.2	-
Hemorrhage	1	0.1	5	0.0	-
Other/not stated	144	17.5	5,801	16.6	4,026-7,576
Total	**825**		**34,922**		**27,735-42,109**

No. = Number

Est. = Weighted estimate (sum of the Weight numeric field in the National Electronic Injury Surveillance System database). The numbers in the Weight field are not whole numbers but include decimals. As a result of rounding to whole numbers when performing analyses, the sum of the estimates for a given variable might not equal the total. The Consumer Product Safety Commission considers an estimate unstable and potentially unreliable when the number of records used is <20 or the estimate is <1,200.

95% CI = 95% confidence interval. Not calculated if the estimate is <1,200.

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tal size, geographic location, and hospital type (general and pediatric hospitals). Professional NEISS coders view the medical charts at participating hospitals and, for patients with injuries that meet NEISS inclusion criteria, collect and code information such as treatment date; patient age, sex, and race; injury diagnosis and body part injured; discharge disposition; consumer product(s) involved in the injury; location where the incident occurred; and a brief narrative describing the incident.[9,10] Data are publicly available and de-identified; thus, the study is exempt from institutional review board approval.

Cases were kickboxing-related lower extremity injuries reported to the NEISS database during 2000-2022. The publicly available NEISS database contains three numeric fields for coding the product involved in the injury (Product_1, Product_2, Product_3). Kickboxing may be assigned either product code 1207 [boxing (activity, apparel or equipment)] or 3257 [martial arts (activity, apparel or equipment)]. However, these product codes are not specific to kickboxing but may be used for other activities as well. The NEISS database contains a text field (field name Narrative) that provides a brief summary of the circumstances of the injury. The NEISS database was searched for all records that included the letter groups "kic" and "box" or "kik" and "box" in the Narrative field. The Narrative fields of the resulting records were individually examined, and any records that involved a kickboxing-related injury were included in the study. That the injury involved a lower extremity was based on the Body_Part numeric field (a field that documents the injured body part) containing codes for a lower extremity (upper leg, knee, lower leg, ankle, foot, toe). The NEISS database contains another numeric field for documenting whether a second body part was injured (Body_Part_2); however, this field was only added in 2018,[10] although this field does not appear to have been used until 2019. For consistency over the entire study period, the Body_Part field alone was examined. (Only 5 cases had a lower extremity coded in the Body_Part_2 field but not in the Body_Part field during 2019-2022.)

The variables examined were treatment year, month (grouped into three-month periods), and day of week; patient age, sex, and race; location where the incident occurred; type of injury (diagnosis); affected body part; and disposition.

Analyses were performed using Microsoft 365 Access and Excel (Microsoft Corporation, Redmond, Washington, US). For all kickboxing-related lower extremity injuries, the distribution of cases and national injury estimates were determined for the variables. National injury estimates were calculated by summing the values in the Weight numeric field in the publicly available NEISS database, and 95% confidence intervals (CIs) were calculated for the estimates. The CPSC considers an estimate unstable and potentially unreliable when the number of records used is <20 or the estimate is <1,200.[9] For those variable subgroups where the estimate

was <1,200, 95% CIs were not calculated.

Results

During 2000-2022, 825 kickboxing-related lower extremity injuries were treated at a sample of US hospital EDs, resulting in a national estimate of 34,922 (95% CI 27,735- 42,109) kickboxing-related lower extremity injuries. This represents 50.0% of the 69,832 total kickboxing-related injuries affecting any body part. The foot was the most frequently affected part of the lower extremity, followed by the ankle and knee (Table 1). The most common types of injury were strain or sprain, contusion or abrasion, and fracture (Table 1).

The annual estimated number of lower extremity injuries varied greatly over the 23-year period (Figure 1). The mean annual estimated number of injuries was 1,292 during 2000-2005, 1,832 during 2006-2011, 1,722 during 2012-2017, and 1,169 during 2018-2022. The estimated number of injuries was 8,257 (23.6%) during December-February, 8,361 (23.9%) during March-May, 9,396 (26.9%) during June-August, and 8,908 (25.5%) during September-November. The estimated number of injuries was 22,057 (63.2%) during Tuesday-Friday and 12,864 (36.8%) during Saturday-Monday.

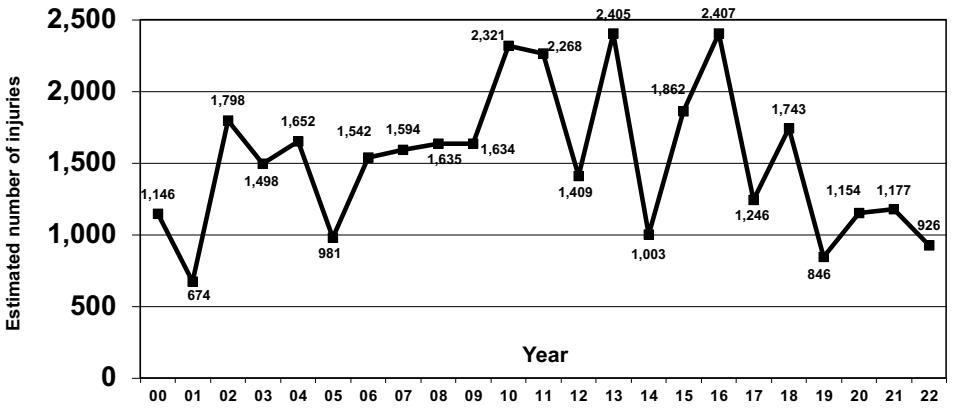

Figure 1: Annual estimated number of kickboxing-related lower extremity injuries reported to the National Electronic Injury Surveillance System, 2000-2022*

*The US Consumer Product Safety Commission considers an estimate unstable and potentially unreliable when the estimate is <1,200.

Table 2 shows the patient demographics of kickboxing-related lower extremity injuries. The highest proportion of patients were age 20-29 years followed by 30-39 years. Roughly equal proportion of patients were male and female. Most patients were White. Table 3 provides

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Table 2. Patient demographics of kickboxing-related lower extremity injuries treated in United States emergency departments, National Electronic Injury Surveillance System, 2000-2022

Variable	No.		Est.		
	No.	%	No.	%	95% CI
Patient age (years)					
0-12	33	4.0	1,269	3.6	608-1,929
13-19	135	16.4	5,664	16.2	3,920-7,409
20-29	305	37.0	12,469	35.7	9,309-15,629
30-39	194	23.5	8,625	24.7	6,242-11,007
40-49	109	13.2	4,206	12.0	2,796-5,616
50+	49	5.9	2,689	7.7	1,649-3,728
Patient sex					
Male	427	51.8	18,131	51.9	13,893-22,370
Female	398	48.2	16,791	48.1	12,802-20,779
Race					
White	435	52.7	20,079	57.5	15,483-24,676
Black/African America	75	9.1	2,726	7.8	1,677-3,775
Asian	12	1.5	323	0.9	-
American Indian/Alaska Native	1	0.1	67	0.2	-
Other	46	5.6	2,277	6.5	1,343-3,210
Not stated	256	31.0	9,450	27.1	6,897-12,004
Total	**825**		**34,922**		**27,735-42,109**

Please see full footnote on Table 1.

the distribution of injuries by location of the incident and patient disposition. The majority of injuries occurred at a place of recreation or sports, and most of the patients were treated or evaluated at the ED and released.

Discussion

This study characterized kickboxing-related lower extremity injuries treated at US hospital EDs. This information is important because this study found that half of all kickboxing-related injuries involved the lower extremity. Healthcare providers can use the information in this study to allocate resources to help manage these injuries. In addition, injury prevention programs can tailor the information they provide to target particular populations.

Almost one-third of the lower extremity injuries involved the foot with the next most frequently injured body parts being the ankle and knee. The most common types of injury were strain or sprain, contusion or abrasion, and fracture. These types of injuries typically are not expected to require extensive medical intervention. This is consistent with the observation that the majority of patients with kickboxing-related

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Table 3. Location of incident and disposition of kickboxing-related lower extremity injuries treated in United States emergency departments, National Electronic Injury Surveillance System, 2000-2022

Variable	No.		Est.		
	No.	%	No.	%	95% CI
Location of incident					
Place of recreation or sports	511	61.9	21,222	60.8	16,418-26,026
Home	49	5.9	2,296	6.6	1,358-3,235
Other public property	35	4.2	1,168	3.3	-
School	17	2.1	730	2.1	-
Not recorded	213	25.8	9,506	27.2	6,941-12,072
Disposition					
Treated or examined and					
released	811	98.3	34,366	98.4	27,272-41,460
Treated and transferred to					
another hospital	1	0.1	72	0.2	-
Treated and admitted for					
hospitalization	3	0.4	48	0.1	-
Left without being seen/against					
medical advice	10	1.2	436	1.2	-
Total	**825**		**34,922**		**27,735-42,109**

Please see full footnote on Table 1.

lower extremity injuries were treated or examined and released from the ED.

Kickboxing-related lower extremity injuries varied from year to year with no clear trend. However, the estimated number of injuries tended to be lower in the most recent years when compared to previous years. This may reflect a decline in the number of people participating in kickboxing, the number of people being injured when participating in kickboxing, the number of injured people seeking treatment at a hospital ED, or a combination of these.

The treatment of kickboxing-related lower extremity injuries was slightly lower during Saturday-Monday than during Tuesday-Thursday. It may be that more people are taking kickboxing classes for exercise during the workweek than on weekends.

Sixty percent of the patients were 20-39 age years. This may be due to people in this age range being more likely to participate in kickboxing. The number of injuries were evenly distributed between males and females, suggesting that both sexes participate in the activity to a similar degree.

There are ways to reduce the risk of kickboxing-related injuries. Participants should warm up and stretch before kickboxing. Participants can wear proper protective equipment, which, in the case of preventing lower extremity injuries, would include shin pads and kick boots (foot pads).

There are limitations to the study.

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Kickboxing-related injury cases were initially identified by selecting those records with the letter groups "kic" and "box" or "kik" and "box" in the Narrative field. If these letter combinations were not used in instances of kickboxing-related injuries, then these cases would not have been included in the study. In addition, temporal changes in kickboxing may reflect changes in the documentation of kickboxing in the Narrative field over time. Furthermore, details, such as whether the injury occurred during a kickboxing competition or during kickboxing practice or exercise, were not available for many records and thus could not be examined. The study only included injuries treated at hospital EDs. Information on injuries treated elsewhere might provide a more complete perspective of kickboxing-related injuries.

In conclusion, half of all kickboxing-related injuries treated at US hospital EDs involved the lower extremity. The majority of patients with lower extremity injuries were age 20-39 years, and patients were evenly divided between males and females. The most commonly reported injuries were strain or sprain, contusion or abrasion, and fracture, and the most frequently affected parts of the lower extremity were the foot, ankle, and knee. Most of the patients were treated or evaluated at the ED and released. ler

Mathias B. Forrester, BS, is an independent researcher in Austin, Texas. Now retired, he previously performed public health research for various university and government programs for 38 years.

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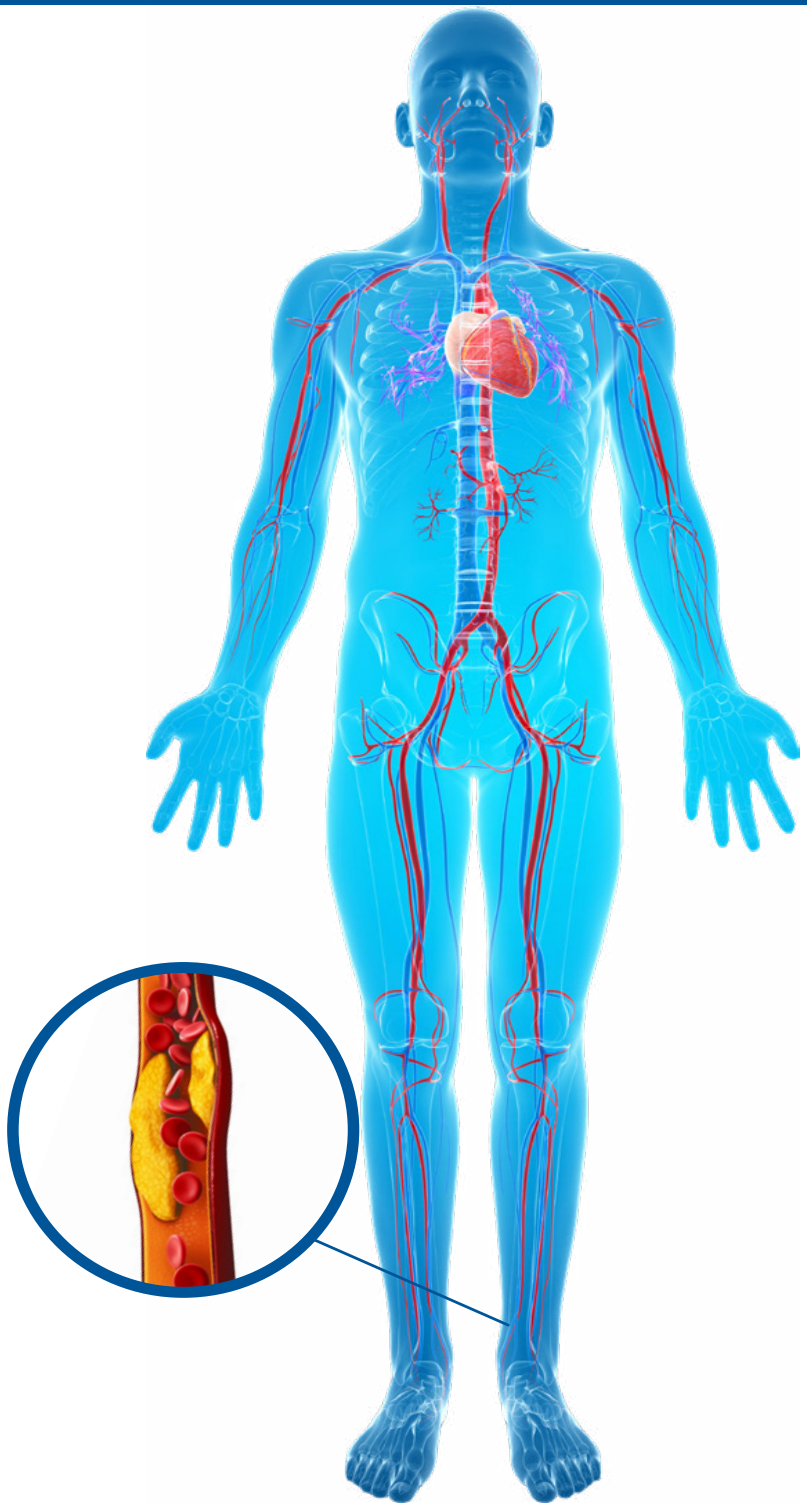

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Epidemiology of 50,000+ Ankle Fractures During a 10-year Period

By Emilia Möller Rydberg, David Wennergren, Caroline Stigevall, Jan Ekelund, and Michael Möller

Large epidemiological studies are needed to elucidate the underlying injury mechanisms, the demographics of each fracture group, and the influence of sex and age on the sustained fracture.

Ankle fractures are the third most common type of fracture and range from simple avulsions that can be treated non-surgically to complex, open injuries that require multiple surgeries and long-term rehabilitation. An increasing incidence of ankle fractures, especially in the elderly, has been reported in several studies. Despite this, there is a lack of up-to-date, comprehensive epidemiological studies including all kinds of ankle fracture. Since 2012, the Swedish Fracture Register (SFR) has prospectively collected data on surgically and non-surgically treated ankle fractures, which have been classified according to the AO/OTA 2007 (Arbeitsgemeinschaft für Osteosynthesefragen/Orthopaedic Trauma Association) classification system. The aim of this study is to describe the epidemiology of ankle fractures between 2012–2022.

Methods

All ankle fractures registered in the SFR (AO/OTA44; Figure 1) from April 1, 2012–March 31, 2022, in patients over 16 years were included in this observational register study. Epidemiological data on age, sex, injury date, injury mechanism, injury type (high- or low-energy trauma), fracture classification, and type of treatment (surgical or non-surgical) were retrieved from the SFR. Information regarding fracture classification included the fracture type and group according to the AO/OTA classification, as well as side and open or closed fracture. For injury mechanisms, the 6 categories (simple fall, fall from a height, unspecified fall, traffic, miscellaneous, and non-traumatic) were used.

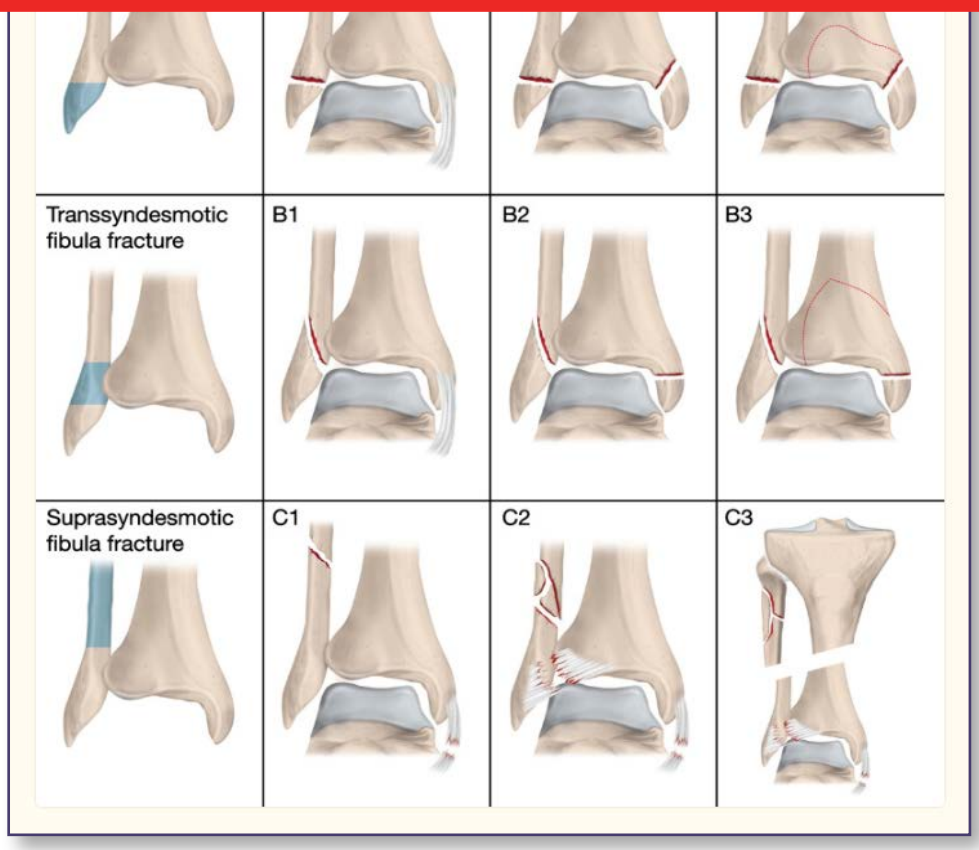

Figure 1. The AO/OTA classification of ankle fractures. Illustration by Pontus Andersson/Pontus Art Production

Results

During the 10-year study period, 56,439 patients sustained 57,443 ankle fractures. Bilateral fractures on the same injury occasion were seen in 156 (0.3%) patients and 845 (1.5%) patients sustained more than 1 ankle fracture (on different injury occasions). Of the latter group, 364 patients sustained another fracture to the same ankle and 481 patients fractured the contralateral ankle.

Of all the fractures in this study, 13,685 (24.3%) were classified as AO/OTA type A, 35,892 (63.6%) as AO/OTA type B, and 6,837 (12.1%) as AO/OTA type C. Within the 3 AO/OTA types, fractures in group 1 (A1, B1, C1) dominated in all 3 types. The A1 group accounted for 69% of fractures, whereas A3 only accounted for 6% of fractures. The B1 group

This article has been excerpted from "Epidemiology of more than 50,000 ankle fractures in the Swedish Fracture Register during a period of 10 years" *J Orthop Surg Res.* 2023;18(1):79. doi: 10.1186/s13018-023-03558-2. Editing has occurred, including the renumbering or removal of figures and tables, and references have been removed for brevity.

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accounted for 52% of fractures (25% B2 and 23% B3). The C1 group accounted for 45% of fractures (27% C2 and 29% C3 (Figure 1). Another 953 fractures were unable to be classified, and 76 were pediatric fractures.

Women (61%) were affected more than men (39%). Only in the age groups below 40 do men have a higher frequency of ankle fractures than women. The mean age at the time of sustaining the fracture was 55 years. Men were found to be younger at the time of injury (mean age, 50 years) compared with the women who had a higher mean age of 58 years. The age and sex distribution for all ankle fractures peaked in total numbers between the ages of 50–70 years.

In total, 1.8% of all ankle fractures were open and were most frequent in the C2 group (5.4%, n = 9). The A1 group had the fewest open fractures (0.3%, n = 29). Open fractures were most common between the ages of 50–80 years. In those over 60 years, open fractures were more common in women than men, whereas men in the 21–50 years age group were more commonly affected. Open fractures of Gustilo–Andersson type II (wound > 1cm) were most common and 2/3 of this group were women. For patients older than 65 years, women dominated in all Gustilo–Andersson injury types. For patients under the age of 65 years, Gustilo–Andersson injuries types I and II were dominated by women, whereas men dominated the Type III injuries.

High-energy trauma was the underlying cause (4.7%, n = 2674) of all the ankle fractures in the study. The AO/OTA-A2 group had the highest proportion of high-energy trauma cases, whereas the AO/OTA-B1 group had the fewest high-energy trauma cases (2.5%, n = 460). High-energy trauma was most common in those age 21–30 years. In all age groups, men were more frequently injured by high-energy trauma than women (Figure 2).

The most common mechanism of injury for all ankle fractures and for each AO/OTA fracture group was a simple fall. Traffic injuries comprised a higher proportion of high-energy trauma (29.2%) and resulted more frequently in open fractures (4.7%) than other injury mechanisms. Fractures with a mechanism of injury that did not fit the other categories, such as sports injuries and fractures sustained in fights, and traffic injuries were associated with male sex and a lower mean age.

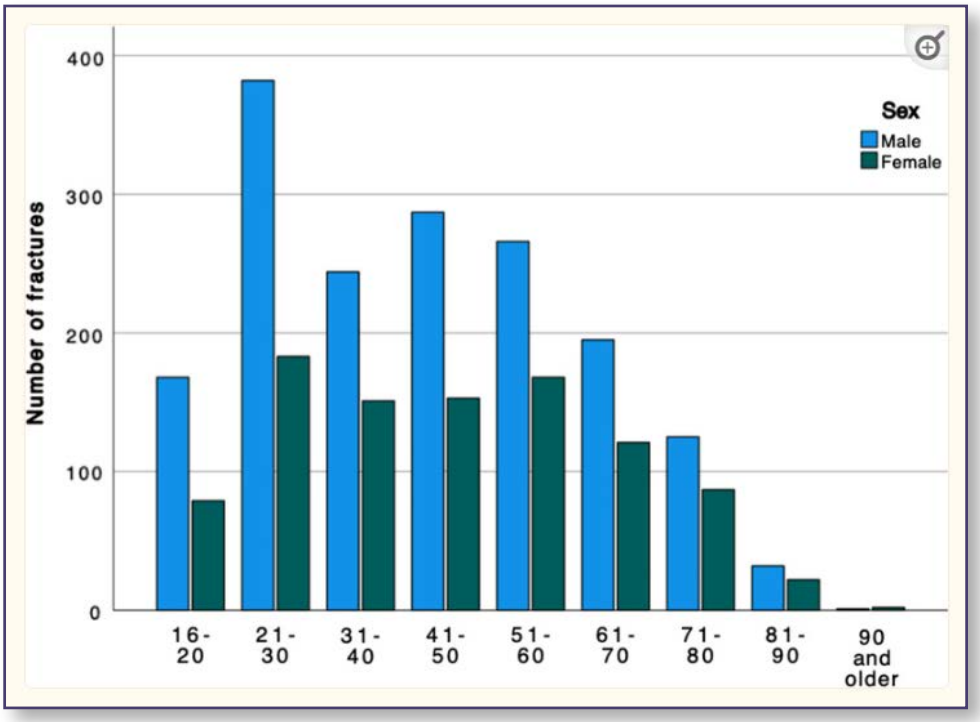

Figure 2. Age and sex distribution of ankle fractures sustained in high-energy trauma. Data shown for April 1, 2012–March 31, 2022.

The number of ankle fractures peaked during the Swedish winter months (November to March), and was found to be driven by fractures sustained by simple falls. When analyzed by fracture type, the same seasonal variation was seen in B-type fractures but not for the other fracture types.

Discussion

The SFR offers a unique opportunity to conduct large epidemiological studies. The classification of ankle fractures, as well as other types of fracture, in the SFR has been validated and shown to have substantial accuracy. Compared with data from the Swedish National Patient Register (NPR), the SFR has been shown to constitute a complete and accurate source of information for epidemiological studies. One of the strengths of this study is that it is a multicenter study that includes ankle fractures of all kinds, treated both surgically and non-surgically and hospitalized and non-hospitalized. Another strength of this study is the length of the time period studied—10 years—which reduces the risk of variations in single years affecting the results.

Conclusions

This study presents the epidemiology of all AO/OTA types of ankle fractures in Sweden over a 10-year period. The study authors have shown that most ankle fractures are caused by a simple fall, affect women more than men, and occur during wintertime. These findings indicate that age-related skeletal fragility, as well as an increasing risk of simple falls in the elderly, may be risk factors. The study also demonstrates that men sustain their ankle fractures at a younger age and are more frequently injured by a high-energy trauma. As further shown, open ankle fractures are most common in women over the age of 60, but the severe open injuries more frequently affect men. This study will contribute to the planning of primary prevention for ankle fractures.

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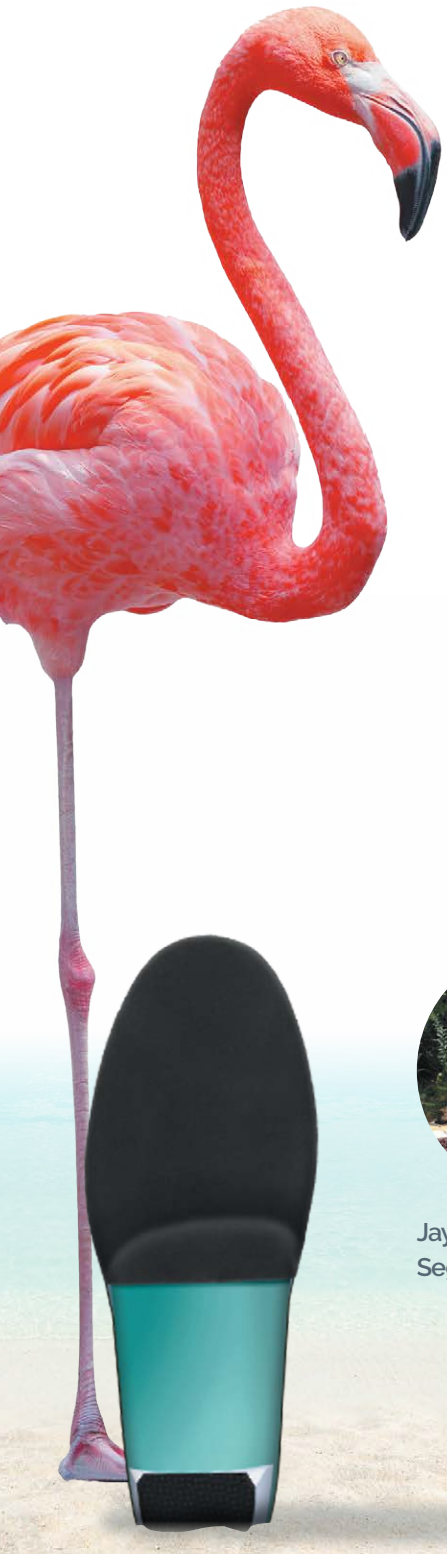

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Measuring Children's Feet: 3D Foot Scanning Compared with Established 2D Manual or Digital Methods

By Juliane Mueller, Monika Richter, Kathrin Schaefer, Jonathan Ganz, Jörg Lohscheller, and Steffen Mueller

In infants and young children, a wide heterogeneity of foot shape is typical. Therefore, children, who are additionally influenced by rapid growth and maturation, are a very special cohort for foot measurements and the footwear industry.

Although knowledge of the high heterogeneity in foot shape in children is evident, coupled with the influence of rapid growth and maturation of children, the footwear industry still bases the last as well as shoe development predominantly just on foot length and ball width. Yet children can have the same foot length but different foot shapes (eg, wide vs narrow). This fosters a mismatch between the manifold foot and shoe shapes.

New measurement techniques (3D foot scanning) allow the assessment of the individual foot shape. However, the validity in comparison to conventional methods remains unclear. Therefore, the purpose of this study was to compare 3D foot scanning with 2 established measurement methods (2D digital scanning and manual foot measurements).

Methods

The study cohort comprised 277 children (125 m/152 f; mean ± SD: 8.0 ± 1.5yrs; 130.2 ± 10.7cm; 28.0 ± 7.3kg). After collection of basic data (sex, age, body height, body weight), the geometry of the right foot was measured in static condition (stance) with 3 different measurement systems (fixed order): manual foot measurement, 2D foot scanning (2D desk scanner), and 3D foot scanning (handheld 3D scanner). Main outcomes were foot length, foot width (projected, anatomical, instep), heel width, and anatomical foot ball breadth. Analysis of variances for dependent samples was applied to test for differences between foot measurement methods (Post-hoc analysis: Tukey-Kramer-Test; $\alpha=0.05$).

Results

Significant differences were found for all outcome measures comparing the 3 methods ($P<0.0001$). The span of foot length differences ranged from 3mm to 6mm with 2D scans showing the smallest and 3D scans the largest deviations. Foot width measurements in comparison of 3D and 2D scans showed consistently higher values for 3D measurements with the differences ranging from 1mm to 3mm. (Table 1.)

Discussion

The study results show that the different methods somewhat under- and/or overestimate the single outcomes analyzed.

All foot dimensions collected with the 3D scanner were greater compared to 2D scanning

This article has been excerpted from "How to Measure Children's Feet: 3D Foot Scanning Compared with Established 2D Manual or Digital Methods," J Foot Ankle Res 16, 21 (2023). https://doi.org/10.1186/s13047-023-00618-y. Editing has occurred, including the renumbering or removal of tables, and references have been removed for brevity.

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Dimension	Outcomes	Methods			*p*-value*	Differences between methods		
		Manual foot measurement (mm)	2D Foot Scan (mm)	3D Foot Scan (mm)		Manual foot measurement vs. 2D (mm)	Manual foot measurement vs. 3D (mm)	2D vs. 3D (mm)
length	Foot length, FL	201.4 ± 18.0	197.5 ± 17.4	203.7 ± 18.1	<0.0001	+3.9	-2.3	-6.2
width	Projected foot width, FW_P	74.9 ± 6.0	76.3 ± 6.8	- -	<0.0001	-1.4	- -	- -
	Anatomic foot width, FW_A	- -	78.0 ± 6.8	80.7 ± 6.9	<0.0001	- -	- -	-2.7
	(technical) Instep width (at 50% foot length), FW_50	- -	67.7 ± 6.0	68.6 ± 6.0	<0.0001	- -	- -	-0.9
	(technical) Heel width (at 20% foot length), HW	- -	51.0 ± 4.6	53.5 ± 4.5	<0.0001	- -	- -	-2.5
breadth	Anatomical foot ball breadth, FB	200.2 ± 17.5	- -	197.0 ± 16.6	<0.0001	- -	+ 3.2	- -

Table 1. Results for all outcome measures for all 3 foot measurement methods (mean ± SD and analysis of variances) and differences between foot measurement methods for all outcome measures

as well as manual foot measurements. One reason could be that the 3D scanner detects the outermost points of the superficial boundaries (eg, metatarsal head) more precisely than the manual foot measurements or the 2D scan when measuring foot length, forefoot width, and heel width. Another reason may be that the examiner pressed the soft tissue surrounding the measuring points with the material of the slide during the manual foot measurement, which can result in smaller measurement values in foot length and/or width. The foot measures collected from the 2D scanning were smaller than those collected using manual measurement methods as well as 3D scanning. One reason for this might be because the shape of the human foot is curved upward at the outer (medial, lateral) edges and does not lie completely flat with the entire plantar surface. Because of this, the footprint on the scanner board might be reduced at the edge of the foot, and the foot scan contour captured tends to be smaller than the actual plantar surface contour. Consequently, a standardized measurement procedure is desirable, and adequate training for the examiner should be carried out before the use/application of the described measurement methods.

The 3D foot scanning is the technological gold standard for the assessment of foot morphology. The advantages of using the 3D scanning system to collect foot measures is the high precision and accuracy of the systems. The 3D foot scanning allows the assessment of volumetric and surface data and provides more detailed information on foot size and foot shape in all dimensions compared to manual measurement or 2D scanning. This is especially important for the growing foot of children. The high initial set-up cost as well as the time needed for processing the data (about 1–2 hours per scan) are disadvantages. Moreover, 3D scanning takes longer than manual foot measurement. However, the 3D measurements can be significantly accelerated by using a stationary camera measurement system placed around the foot instead of the handheld mobile scanner.

Conclusions

Based on the presented results, this study supports the use of 3D foot scanning measurement for collecting foot anthropometric data in school children 5–10 years old, especially as a basis for collecting detailed information on foot shape and size in all 3 dimensions for the last construction of children shoes. The findings suggest that when comparing foot data, it is important to consider the differences caused by new measurement methods. Differences of about 0.6cm are relevant when measuring foot length, as this is the difference of a complete shoe size. Hence, correction factors may be required to compare the results of different measurements appropriately. For application, it shows the importance that the measurement method for the feet should be in line with the measurement method of the shoe/last. Based on the presented (3D) data, a foot typing might be advantageous for further development of children shoe lasts that account for a higher number of foot shape variability in children. (ler)

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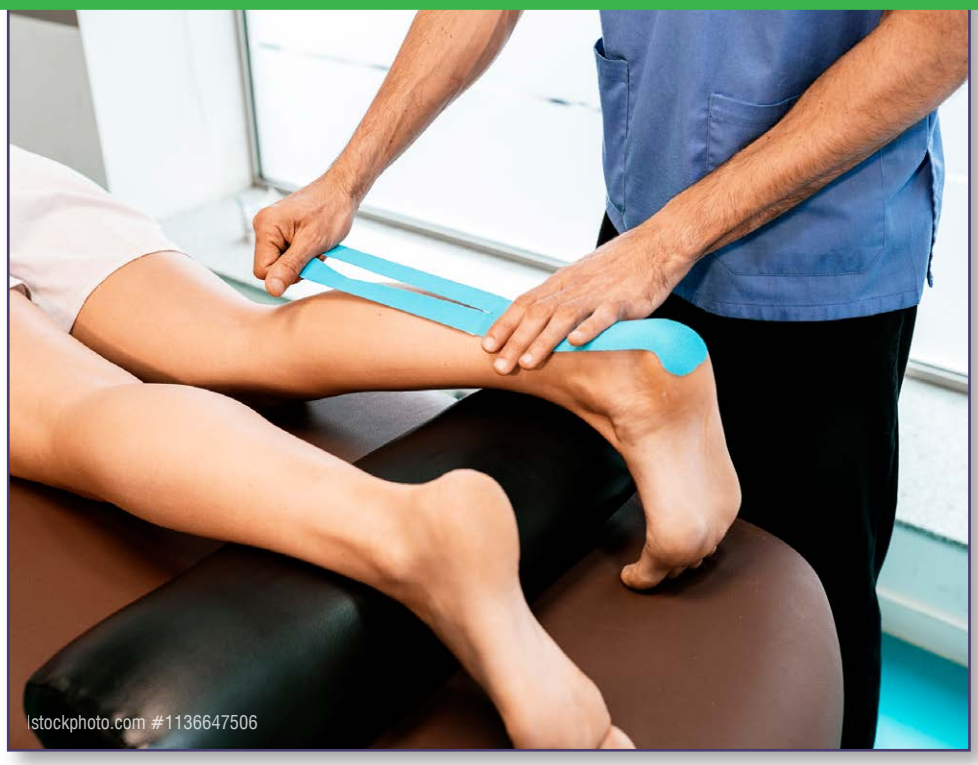
Kinesiology Tape for Prevention & Treatment of Sports Injuries

By Adéla Andrýsková and Jung-Hoon Lee

The growing use of kinesiology tape requires guidelines for safe and effective application.



The popularity of kinesiology tape (KT) across the world is rising as witnessed by its common appearance on athlete's bodies during the Olympic games or football leagues over the last decade. Therefore, the results of the application of KT will be important to sports physiotherapists, trainers, and sports medicine physicians. Originally developed and used for the treatment of injuries, joint stabilization, and pain reduction, nowadays, this elastic cotton fabric tape is particularly valued for its injury prevention and performance enhancement properties. Kinesiology taping, in comparison to many other treatments, is simple, affordable, not invasive, does not cause pain, and requires a relatively small amount of time for application.

While some recent studies have questioned its effectiveness, it is important to note that several techniques of kinesiology taping exist and the application of KT for certain pain, injury prevention, performance enhancement, etc., can differ significantly depending on each technique. Nevertheless, a basic set of rules for the application of KT to prevent any undesired side-effects should be strictly followed when using any techniques.

Avoid Skin Irritation

The most fundamental rule is that the skin of the taping subject must be clean, without any dirt, oils, or sweat. Also, longer body hairs, which could hinder proper adhesion, must be shaved prior to taping. Besides these well-known principles, there is another particularly important rule of kinesiology taping that is either unknown or not respected: keeping the tape on for a maximum of 24 hours. Subjects should never wear KT for more than a day. There are several reasons for this limitation: Skin troubles are the most frequent problems. This does not solely mean allergic reactions that can be provoked by the glue, which adheres the fabric to the skin. Skin problems may arise particularly due to perspiration, which is part of everyday activities. If KT contaminated by sweat is worn for more than a day, it may cause skin irritation. It is also recommended to remove the tape immediately after showering as the wet tape can provoke undesirable skin effects. If undesirable side-effects (as itchiness, skin irritation, etc.) appear, the successive application of kinesiology tape is impossible, and treatment must be ceased. Thus, increased attention needs to be paid to the condition of the skin. If itchiness or another undesirable effect appears, KT must be removed immediately.

Avoid Stretching – Skin and Tape

The 24-hour application rule is also recommended due to the constant movement of a subject. Where KT is applied, and the level of stretching of the tape may vary based on treatment progression. Therefore, taping techniques need to be modified day by day as the treatment continues.

Another fundamental factor is the skin's adaptation to stimulation created by KT. To

This article has been excerpted from "The Guidelines for Application of Kinesiology Tape for Prevention and Treatment of Sports Injuries." *Healthcare (Basel)*. 2020 May 26;8(2):144. doi: 10.3390/healthcare8020144. Editing has occurred, including the removal of references for brevity. Use is per CC 4.0 International License.

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Continued from page 53

provide effective skin stimulation, it is necessary to apply new KT every day.

Not stretching the origin and insertion areas of KT is one of the basic rules of taping as well. Approximately 2–3 cm of the starting and ending points of the tape need to be applied to the skin without any stretching. Violation of this rule may cause skin problems leading to discontinuation of treatment.

Even though elasticity is a one of the biggest advantages of KT, it is not recommended to stretch the tape excessively. This principle also applies to skin stretching. The skin should not be stretched excessively before the application of tape. After the application of tape, it is necessary to assure that the tape adheres to the skin properly, but vigorous rubbing of the tape should be avoided. These recommendations are made to prevent skin irritation. For highly sensitive areas, apply hypoallergenic undertape (50 – 75 mm) to the origin and insertion areas before applying KT.

Timing

As for timing, it is essential to give at least 10 min for the body to adapt to the KT before any activity. If excessive perspiration during physical activity occurs, athletes should take a shower afterward and remove the KT when still wet.

Do not apply KT to the abdominal area immediately after food consumption; doing so may generate mild digestive troubles.

Whole Body Not Just Parts

Many practitioners focus only on the body part that needs to be fixed, but it is essential to see the body as a whole system. Segments of the human body are interconnected by the kinetic chain. Therefore, movement of one body part influences another one. In the case of athletes, physicians tend to concentrate on limbs, as those are perceived as a base for movement. However, since the core muscles serve as a stable foundation for limbs' movement, it is necessary to stabilize the core muscles first to achieve improved limb movement. In other words, to improve the movement of distal body parts, the proximal parts must be stabilized first.

The same principle applies for chronic pain in limbs. In such a case, the physician should not concentrate only on the elevation of the pain but should find the origin of the pain, which may be located in proximal parts of the body. Otherwise, taping may be ineffective, or the pain will be relieved only temporally and reappear.

Many other factors need to be considered while choosing the appropriate taping technique to achieve desired results, but the principles described above should never be omitted. If a solid foundation of rules for taping is established and current techniques are enhanced (or substituted by new ones), treatment by KT may bring more various and effective results than is expected. ler

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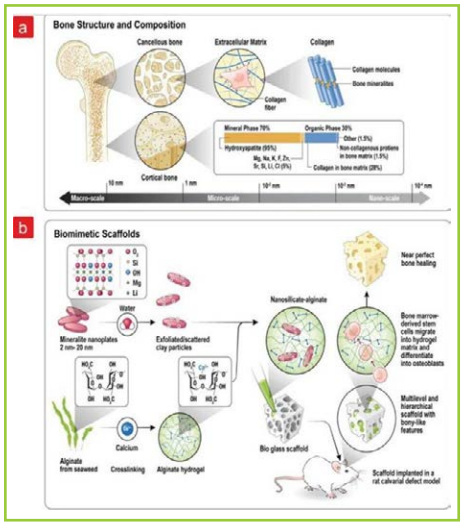
A team at Technical University of Denmark (DTU) Health Tech led by Associate Professor Alireza Dolatshahi-Pirouz, PhD, have made a leap forward in tissue regeneration by creating a multi-leveled scaffold that encompasses properties of native bone on the nano-, micro-, and macroscale. The researchers have described the discovery of near-perfect bone healing in a rat model after only 8 weeks, using their scaffold—and without using growth factors. In addition, the scaffold is combinatorial and can simultaneously release several essential bone minerals while covering mechanical properties, ie, the compressive strength needed to match those of cancellous human bone.

"The implications of these results are enormous, and our aim is now to lower the healing time to 4 weeks and reach almost instant tissue regeneration without using endocrine factors and cells," said Dolatshahi-Pirous. "We will also be looking into whether this could be used for other tissues."

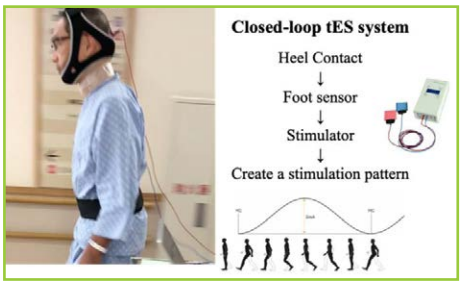


(a) Schematic representation of the (a) bone structure and its composition ranging from nanometers to micrometers and (b) development of biomimetic scaffolds containing the various steps for preparing a combinatorial hydrogel/scaffold.

By incorporating stem cells, more bioactive components such as collagen and gelatin coatings that increase native cell migration into the scaffolds, and electromagnetic stimulation, it could pave the way for rapid healing of soldiers suffering from critical musculoskeletal fractures or civilians suffering from traumatic injuries. These people are hospitalized for months, with a long road to recovery.

Notably, this new scaffold was made primarily from glass, alginate and nano silicate—already US Food & Drug Administration —approved materials, which significantly reduces hurdles for regulatory clearance. This means the scaffold can be used more confidently and efficiently in clinical settings, accelerating development and improving patient outcomes.

BRAIN STIMULATION IMPROVES WALKING IN PATIENTS WITH PD



Patient with Parkinsonian gait disturbances seeking brain stimulation to improve walking dynamics. A sinusoidal waveform was utilized to deliver electrical current on the cerebellum. The initiation of each current coincided with the moment of heel contact on the affected side during a self-paced 4-minutes gait.

Using a novel neuromodulation approach that incorporates gait-combined closed-loop transcranial electrical stimulation (tES), a team of researchers from Japan demonstrated significant gait improvements in patients with various neurological disorders including Parkinson's disease (PD).

While non-pharmacological approaches like transcranial direct current stimulation show promise in improving motor function, recent research focuses on gait-combined closed-loop stimulation, which synchronizes brain

stimulation with the individual's gait rhythm.

To this end, the clinical researchers from from Shinshu University and Nagoya City University recruited 23 patients with PD or Parkinson's syndrome. All study participants were randomly assigned to receive either the active treatment or a "sham" treatment that mimics the active treatment but does not offer any therapeutic benefit. During the course of the trial, an electrode carrying a low current (up to 2mA) was externally affixed to the occipital region of the head. A reference electrode was then placed in the neck region to establish a stable electrical reference point and to complete the electrical circuit. The treatment included performing tES on the cerebellum in a non-invasive manner. The brain side showing severe impact was specifically targeted during the electrotherapy.

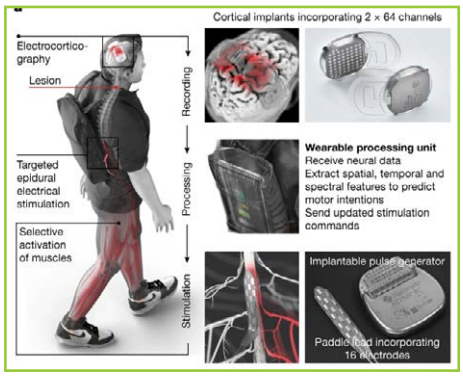
The therapy showed encouraging results after just 10 repetitions. The treatment group showed a significant improvement in gait parameters including speed, gait symmetry, and stride length. Although the study has certain limitations, it suggests that the personalized brain stimulation, synchronized with individual gait rhythm, can effectively enhance gait function in PD and has the potential to be used as an adjunct therapy for gait rehabilitation.

AIR CUSHIONED INSOLES THE WEARER CONTROLS

PopSole™ is a versatile, stress-relieving insole composed of tightly packed bubbles in an anatomic position. The arch and metatarsal pad are multi-level and may be immediately customized to accommodate a lower arch by popping the overlying bubble. For localized foot pain or targeted pressure relief after a foot procedure the PopSole kit includes a pen, push pin, and waterproof sticker to mark the area of pain, pop and deflate the corresponding bubble, and apply a sticker to maintain deflation. These insoles provide massaging stimulation bubble side up or can be flipped and reversed for a smooth feeling (especially for feet with nerve sensitivity). They are perfect in a sensible shoe but may also enhance existing surgical shoes and CAM walkers. Remove current insole, trim to fit, and walk on air.

PopSole
412/550-7653
popsole.com

"DIGITAL BRIDGE" ENABLES PARALYZED



Two cortical implants composed of 64 electrodes are positioned epidurally over the sensorimotor cortex to collect ECoG signals. A processing unit predicts motor intentions and translates these predictions into the modulation of epidural electrical stimulation programs targeting the dorsal root entry zones of the lumbosacral spinal cord. Stimulations are delivered by an implantable pulse generator connected to a 16-electrode paddle lead.

MAN TO WALK

A team of Swiss and French neuroscientists and neurosurgeons reported that they have re-established the communication between the brain and spinal cord with a wireless digital bridge, allowing a paralyzed person to walk again naturally. The subject, a 40-year-old man who suffered a spinal cord injury following a bicycle accident that left him paralyzed over 10 years ago, was able to regain natural control over the movement of his paralyzed legs, allowing him to stand, walk, and even climb stairs.

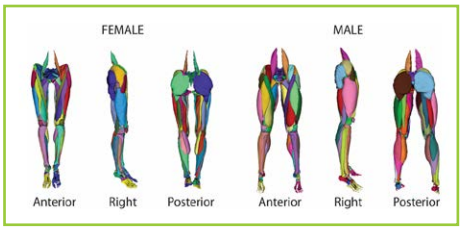
The brain computer interface (BCI) involves 2 electronic implants: 1 on the brain, the other on the spinal cord. The technology for the brain implant, called WIMAGINE®, was implanted above the region of the brain that is responsible for controlling leg movements. A neurostimulator connected to an electrode array was positioned over the region of the spinal cord that controls leg movement.

"Thanks to algorithms based on adaptive artificial intelligence methods, movement intentions are decoded in real time from brain recordings," said team member Guillaume Charvet, head of the BCI program at the French Alternative Energies and Atomic Energy Commission. "These intentions are then converted into sequences of electrical stimulation of the spinal cord, which in turn activate leg muscles to achieve the desired movement. This digital bridge operates wirelessly, allowing the patient to move around independently."

Rehabilitation supported by the digital bridge enabled the subject to recover neurological functions that he had lost since his accident. Researchers were able to quantify remarkable improvements in his sensory perceptions and motor skills, even when the digital bridge was switched off. This digital repair of the spinal cord suggests that new nerve connections have developed.

ONLINE LIBRARY OF 3D LOWER EXTREMITY MUSCULOSKELETAL GEOMETRY

As part of research funded by the National Institutes of Health, the University of Denver Center for Orthopaedic Biomechanics has made available a repository of 3D models of



the human lower extremities created from the Visible Human Female and Male imaging datasets.

Complete 3D musculoskeletal geometries were extracted from the National Libraries of Medicine Visible Human Female and Male cryosections. Muscle, bone, cartilage, ligament, and fat from the pelvis to the ankle were digitized and exported in shareable formats and made available for download. While a substantial amount of published work has been derived from the Visible Human Project, this is the first time a large number of musculoskeletal 3D geometries are being made available to the public that include both the male and female specimens. In total 260 geometries from the Visible Human Male and Female were extracted from the cryosections consisting of 76 muscles, 28 bones, 16 cartilages, 8 ligaments, and 2 fat geometries per subject. The library is available at multiple layers of processing and in a final form with no overlap between individual structures. This library is made available to motivate continued work in multi-scale, high-fidelity musculoskeletal modeling and promote reuse and continued development of the dataset.

To access the online library, visit https://digitalcommons.du.edu/visiblehuman/#.

FILLAUER MOTION CONTROL PRESIDENT RETIRES, VP NAMED

Art Dyck, the president of Fillauer Motion Control, has retired effective August 31. Dyck has been in this position for 6 years and with the company for 35 years.

Jon Winegar has been named regional vice president of Fillauer Motion Control and will assume Dyck's responsibilities while continuing in his current leadership role at Fillauer Composites. Winegar has 14 years of experience with Fillauer, focused on designing and manufacturing products.

CALF COMPRESSION SLEEVES

Comrad's calf compression sleeves were developed to provide relief by addressing shin splints, calf cramps, and fatigue in the lower leg. They are designed with performance in mind as they are perfect for running, cycling, and training. The compression features help to boost performance, stabilize muscles, and speed up recovery. While they are designed with athletic performance in mind, compression socks and sleeves are also perfect for anyone who works long hours on their feet, and are the solution to better circulation and decreased discomfort in the lower extremities. The sleeves are made with SmartSilver™ ions to help reduce odors and bacteria, keeping feet fresh, and moisture-wicking mesh keeps feet dry, cool, and comfortable. 20–30 mmHg True Graduated Compression™ for Comrad's firmest level of support. Available in size small to extra-large.

Comrad
comradsocks.com

WALKING POLES WITH ERGONOMIC GRIP

York Nordic is pleased to announce the introduction of the new Motivator walking poles with a newly designed ergonomic grip that lends support to Nordic Walking to ensure maximum benefit and comfort to the user. The Motivator offers patented (pending) contoured

grips with 2 thumb support positions to stabilize the trapeziometacarpal joint and reduce strain on the carpometacarpal (CMC) thumb joint. This strapless grip design improves proprioception and offers state-of-the-art ergonomics and best-in-class hand support for the biaxial saddle joint. The result is a 10 times reduction in stress at the CMC joint, minimizing torsional load while providing balance and stability to the patient looking for motivation to begin walking more confidently. As with the company's other walking poles, the Motivator is available in 20 custom designs that provide style and flair.

York Nordic
800/930-5928
yorknordic.com

BIO-ENGINEERED SKIN SUBSTITUTE

Helicoll is a bio-engineered skin substitute product made of high-purity Type-I collagen (>97% pure). It is designed to accelerate

tissue regeneration, repair, and heal wounds caused by burns, trauma, diabetes, or other chronic conditions such as bedsores or venous ulcers. One of the added advantages is its longer shelf life of up to 3 years under ambient room temperature conditions. Helicoll, an uncross-linked biocompatible collagen, exhibits a unique ability when applied tightly over the wound, where it osmotically absorbs glucose. This glucose-absorbing property reduces the glycosylation process of collagen in the wound bed. As a result, the collagen in the wound bed can undergo normal maturation, facilitating faster healing of diabetic wounds.

Helicoll
510/396-8581
hellicoll.com

LIPEDEMA GARMENT WITH FLEXFIT COMFORT ANKLE

The Marena Group has launched a product designed specifically to assist patients recovering from lipedema reduction surgery. This new compression garment features the innovative FlexFit Comfort Ankle™, a unique foot construction with gliding compression panels, that allows for improved lymphatic drainage, blood flow, and mobility at the ankle. This feature is crucial when it comes to comfort and pain management during the recovery process. This new lipedema garment features the company's proprietary TriFlex Fabric™, which is known for its recovery benefits after liposuction in the post-surgical market. It contains features such as 3D stretch, moisture wicking and cooling properties, silhouette forming capabilities, and antimicrobial properties to ensure ultimate comfort, compliance, and results.

Marena Group
888/462-7362
marena.com

ORTHOTICS FOR GOLFERS

Custom, flexible ParFlex Plus® Orthotic for Golfers offers a unique forefoot stabilization, allowing for a stronger follow through. Wearers can benefit from improved proprioception, which is a key element of athletic performance and injury prevention while participating in the sport. A study showed wearing ParFlex Plus custom-fit, flexible orthotics for 6 weeks and before and after completing 9 holes of simulated golf could increase club-head velocity (CHV) by up to 3 to 5 mph, as well as intensifying driving distance—improving stroke distance, typically between 9 and 15 yards. The design includes magnets that help to increase energy and stamina on the green while reducing fatigue. As featured in all Foot Levelers custom, flexible orthotics, ParFlex Plus is built with a proprietary 3 Arch Advantage™, which provides support to all 3 arches of the foot to address total body wellness from the ground up.

Foot Levelers
800/553.4860
footlevelers.com

WIRELESS, ROBOTIC SYSTEM TO ASSIST IN PERFORMING KNEE REPLACEMENT

THINK Surgical's TMINI™ Miniature Robotic System has received 510(k) clearance from the US Food & Drug Administration. The system includes a wireless robotic handpiece that assists surgeons in performing total knee replacement. Following a CT-based 3D surgical plan, the TMINI robotic handpiece automatically compensates for surgeon hand movement to locate bone pins along precisely defined planes. Cutting guides are then connected to the bone pins for accurate bone resection. TMINI is easy to use and replaces many of the instruments currently used for knee replacement surgery. With its small footprint, open implant platform, and intuitive workflow, the system opens up robotic possibilities for more clinics, operating rooms, and surgeons.

THINK Surgical
510/249-2300
thinksurgical.com

DO YOU HAVE A NEW PRODUCT OR NEWS?

We want to hear about your new product, news, or innovation! We want to hear from you! Please send information to Laura@LERmagazine.com

Source: Collings TJ, Bourne MN, Barrett RS, et al. Gluteal muscle forces during hip-focused injury prevention and rehabilitation exercises. Med Sci Sports Exerc. 2023 Apr 1;55(4):650-660. doi: 10.1249/MSS.0000000000003091.

OrthoRite orthotics

always a step ahead

Graph-Rite

The Graph-Rite can be used for most applications including sports. It enhances biomechanical correction using a lightweight, thin material. Manufactured for the active patient or athlete who needs control in tighter fitting foot gear.

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