OATech Network Plus

Biomechanics Beyond the Lab: Remote Technology for Osteoarthritis Patient Data – Executive Summary

Technology for the gathering of biomechanical and functional data for OA is traditionally carried out using established lab-based systems: [1, 2] both fixed gold standard systems e.g. Motion Capture, or increasingly popular wearable systems incorporating IMUs [3-5].

The Covid-19 pandemic and desires to improve efficiency, reduce cost and flexibly collect 'real-world' data has driven an interest in technology suitable for the collection of data out of a laboratory environment [6-10].

This scoping review aimed to identify technology suitable for gathering biomechanical parameters pertinent to OA, that had been validated against gold standard technology, was suitable for remote use, and commercially available, therefore presenting an alternative for OA researchers.

Table 1. A wide number of technologies were identified and classified by application / location of use with the majority categorised as Part Remote (65%).

Portable	Requires fixed research environment e.g. laboratory or clinic	Requires specialist trained users to gather data
Part Remote	Can operate in most environments with some restrictions e.g. connectivity, power	Set up and data harvest requires specialist, but data can be gathered without specialist present
Fully Remote	Able to operate in any environment e.g. home, outdoors	Capable of being used and managed unobserved by participant with minimal support

Given the validation criteria, technology was not quality assessed for accuracy, cost or usability factors (e.g. battery life, range of use, method of data recovery and analysis) or the advantages/disadvantages for researchers such as training, or technology support/maintenance.

Embracing these new technologies offers OA researchers the potential to simplify methods, reduce the cost and necessary skills for data collection, and widen the locations and environments in which data can be collected. Technology that can operate remotely could facilitate the gathering of objective data, a better understanding of real-world OA, its impact on the patient and effective treatment monitoring.

Table 2. Commercially available technologies identified for remote use.

	Description	Metric	Location
BioStamp https://www.mc10inc.com/ [11, 12]	Skin adherent sensor patch with accelerometer and gyroscope (IMUs)	Tri-axial linear/angular motion, ROM, joint angles, gait SPTs.	Part Remote
Echo5d from Atlas5D https://atlas5d.com/our-technology/ [13]	Ambient measurement system – non wearable activity monitoring	Gait SPTs - ADLs	Part Remote
Encephalog from Mon4t https://mon4t.com/movement/ [14]	Smartphone app (integrated tri-axial accelerometers and gyroscopes).	Gait SPTs – specifically in relation to TUG parameters.	Remote
GaitSmart https://www.gaitsmart.com/ [15, 16]	IMU's with proprietary software	Gait SPTs, ROM, kinematic parameters.	Part Remote
Loadsol https://www.novelusa.com/loadsol [17]	In shoe worn insole device	Plantar peak force.	Part Remote
McRoberts Dynaport MoveTest https://www.mcroberts.nl/products/movetest/ [18]	Single IMU belt worn device	Gait SPTs.	Portable
OpenGo by Moticon https://moticon.com/opengo [19]	OpenGO (wireless shoe insole) with Moticon smartphone application	Kinetic parameters (KAM), gait SPTs.	Portable
Physilog GaitUP https://research.gaitup.com/physilog/ [20]	Two Physilog IMU's and proprietary Gaitup software system	Gait SPTs.	Part Remote
SensFloor https://future-shape.com/en/gait-recording/ [21]	Capacitive sensor embedded flooring with recording outputs	Gait SPTs.	Part Remote
Theia3D Markerless https://www.theiamarkerless.ca/ In conjunction with Qualisys (Qualisys AB, Sweden) Miqus cameras [22]	Markerless motion capture software for processing of camera generated video to produce 3D kinematic data (segments and rotation matrices) that is ready for analysis.	Kinematic SPT's, segments, angles.	Portable

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