

Hand Osteoarthritis and its Disability: What Does the 2024 Evidence Base Imply or Exclude?

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Abstract

Background: Hand osteoarthritis, a disabling painful health condition, has been a topic of great interest to clinicians, patients, and researchers for many years with no definitive consensus on its origins or most efficacious form of treatment or prevention. While various determinants such as age and genetics or both have been proposed to have an influence on this condition, what does the current literature imply?

Aim: Following a comprehensive review conducted in 2023, this mini review sought to examine what researchers have reported over the past 2024 period concerning hand osteoarthritis and the possible role one or more muscle function deficits may play in the disease onset and progression, if any.

Methods: Available English language related literature housed in PUBMED were searched.

Results: Cumulative findings appear to support an important future role for efforts to examine biomechanical disease correlates among other measures to heighten evaluation accuracy.

Conclusion: Future well-designed studies of various hand osteoarthritis samples using clinically relevant biomechanical, neurological, and biochemical outcome instruments are likely to prove extremely valuable in explaining the disease variation, who is at risk or not, some aspects of hand osteoarthritis etiology and modes of averting both the onset and progression of its disabling and costly manifestations.

Keywords: Biomechanics; Hand Function; Hand Osteoarthritis; Intervention; Older Adults

Background

As identified in a comprehensive Chinese based analysis, chronically disabling osteoarthritis, a disease affecting one or more freely moving joints, such as the hip, knee, and hand joints is increasing in prevalence with many young adults now being affected, not only the older population. Accompanied by progressive or oppressive unremitting bouts of disabling pain and declining functional abilities, once thought to be largely due to the effects of upright weightbearing, both weight-bearing as well as non-weight-bearing joints, such as those of the hands may be duly affected. At the hand, the disease features, while similar to those at other affected joints, such as pain, stiffness, joint swelling, and a reduced ability to use the hand continue to present an immense human challenge and one extremely difficult to mitigate or prevent, especially among those most impacted, namely the older adult, and especially the older woman [1]. A disease that is diverse in its own right as far as clinical presentation goes [2], its five phenotypes found to date at the hand present an immense public health challenge in most countries with aging populations due to its oftentimes progressively burdensome irrevers-

ible interconnected biological, biochemical, cellular, molecular, and joint tissue pathological changes, as well as adverse psychological manifestations [2, 3]. The condition at the hand can also occur in tandem with osteoarthritis at other joints and can ‘spread’ from affecting a single joint, such as the hand, for example if a fall due to the subnormal use of an assistive device in the case of an acute pain episode that is not anticipated, and resulting in a possible injury and wrist fracture.

In sum, regardless of cause or affected joint site, the manifestations of hand osteoarthritis may implicate the whole joint rather than only its cartilage and bone components, including synovial membrane alterations with subsequent multiple cellular and functional alterations, and degradation products that may trigger a persistent state of low-grade joint tissue inflammation [3].

Unfortunately, despite numerous intensive research studies and the development of various disease modifying drugs [4], the condition commonly fails to respond successfully to most currently advocated pharmacologic approaches. In addition, even when apparently sound recommendations are made, for example, self management, this approach may not be feasible among adults in the higher age groups if their hands are impaired in some way, for example in feeding activities or applying hand splints. Moreover, injections may not be helpful in all cases and may prove harmful if followed by unanticipated infections, and while often pain relieving may evoke excess hand usage as a result, among other harmful factors [4], and may be unsafe especially if inaccurate injection applications and repeated injection bouts damage cartilage and possible tendon integrity [6]. While surgery may be desirable at some point if the disease worsens with age, that at the hand is often not indicated, moreover, while reported as effective the long term outcome of denervation surgery to mitigate hand pain is not clear [7]. While possibly failing to prove aesthetically satisfying, surgery may have the unwanted side effect of increasing pain sensitization risk [8], while failing to address psychological and cognitive issues that foster disability. To date, exercises or rest commonly advocated for treating hand osteoarthritis cannot be said to provide uniform long lasting mitigation of the condition to any degree at present, despite their widespread usage.

Other recommendations such as weight control strategies and joint protection may not prove helpful for achieving pain relief and enhancing joint status in all cases, especially if these are not carefully construed and titrated in light of the individual, and their underlying osteoarthritis pathology. This includes that related to muscle or associated sensory-motor sources of osteoarthritis pathology at the hand that may reside at any point in the hand neural control pathways, including the tendons [9] and that govern joint biomechanics and its pathogenic influence [10].

Since a failure to mitigate the degree of suffering attributable to hand osteoarthritis may prevent an older adult from ‘aging in place’, and will likely heighten the need for some form of assistance and possible full time care, efforts to examine all possible contributing factors that influence this condition may yet have far reaching meaningful life quality as well as economic impacts for a fair number of affected aging individuals as well as society [11]. Alternately, a failure to do this might theoretically exacerbate the multiple adverse disabling consequences of hand osteoarthritis, including emotional, social, and life quality factors, progressively and severely, especially in the face of persistent or unrelenting hand pain and unidentified muscle abnormalities that are modifiable.

Rationale and assumptions

As in the case of osteoarthritis at the hip or knee, current options to promote joint comfort in the case of hand osteoarthritis remain limited and rely largely on a variety of medications believed to reduce pain, but that can also have adverse health effects, such as narcotic dependency and local exacerbation of joint cartilage tissue destruction. Some of the pain at the hand experienced by the older osteoarthritis sufferer may however stem from abnormalities in the structure and function, strength, and endurance of one or more muscles surrounding the diseased joints, and hence this possible often unrecognized pain source has been deemed important to consider and possibly to target. In turn, severe osteoarthritis associated hand pain may have an unanticipated impact on important protective aspects of joint associated neural programming related to the timely and optimal execution of muscle responses to perturbations and the ability of the affected individual to withstand prolonged hand usage. However, the specific muscle abnormalities that may underpin pain and the risk of hand joint damage and that could impact joint biomechanics as well as biochemistry and neuromotor plus joint physiology or be induced by the disease have not been studied or clearly clarified to any generalizable degree. As sup-

ported by most recent authors in this field however, muscles may have a strong bearing on the ability to withstand repetitive loads, as well as on life promoting hand mobility, grasping, pinching, hand dexterity and manipulation activities. Essential too, for fostering joint nutrition processes, bone physiology, and muscle-bone cross-talk, muscle factors may be especially important to identify, characterize, and possibly to specifically intervene upon strategically in the case of hand, as well as other forms of osteoarthritis, and while apps directed to exercise self-management and other strategies may have some efficacy, they may not be easy to use or apply in a targeted way in light of the disease variability [12], perhaps especially in the relatively challenging subset of hand osteoarthritis where the disease accelerates rapidly or where some form of bone cutting and prosthetic surgery or radiotherapy has been implemented [13, 14].

Aim

This mini review aimed to examine what is new as regards aspects pertaining to hand osteoarthritis and as published in 2024 and highlighted on PUBMED.

Hypotheses

It was hypothesized that where studied:

1. Hand osteoarthritis can be shown to be a burgeoning disease with few solutions.
2. It was further hypothesized that among the varied forms of hand osteoarthritis that prevail, muscle abnormalities that would be predicted are not well documented.

Methods

To provide material that may help enhance comprehension of this current idea, available data accessible to the public and located in PUBMED detailing some of the natural features of hand osteoarthritis and possible muscle correlates were initially searched for 2024 data, as this specific data base houses a majority of the world's most salient English language peer reviewed journals published in the medical field. Studies that did not encompass hand osteoarthritis in the older population in some way were excluded, along with muscle morphology investigations, surgically oriented and exercise studies, measures of muscle that were structural rather than functional, preprints, study proposals, and abstracts. The term motor function was used to describe aspects of muscle coordination, or neuromuscular responses to extrinsic movements or various stimuli. No distinction was made as regards which hand osteoarthritis joints were affected specifically, or whether the hand osteoarthritis was unilateral or bilateral, recent or chronic, and the term applied to one or more joints deemed to exhibit clinical and radiographic pathological changes, including the carpometacarpal joint, the distal interphalangeal joint, and the joints of the thumb. No subgroup analyses, a topic previously assessed that showed limited discriminatory findings was forthcoming. Genetic versus non genetic types of hand osteoarthritis were treated similarly. All types of clinical study were deemed acceptable. No distinct cause-effect relationship was assumed as muscle abnormalities at the hand may prove to be precursors, as well as adaptive disease correlates, or both. All modes of assessing muscle function at the osteoarthritic hand were deemed acceptable, including electromyography, electronic force sensors, measures of joint kinematics and muscle timing, for example. With immensely diverse research questions and approaches, only a descriptive summary was deemed feasible.

Results

While there is limited detailed information about hand osteoarthritis in general, as well as how individuals with hand osteoarthritis perform or have challenges performing activities of daily living [15], it is clear older adults are at modest to high risk for this condition and a lower than desirable life quality, and that the disease occurs in multiple forms that are being classified gradually [18].

Regardless of disease site, and manifestation, it appears that among the determinants of hand osteoarthritis pain, body mass, mental health, and employment have a cumulative as well as an independent array of impacts [16]. As well, increased alcohol intake is associated with radiographic severity of hand osteoarthritis in men [17].

In some patients, this global burden can be as severe, regardless of whether a single hand joint or multiple hand joints are affected. In addition to pain, functional limitations and frustration in undertaking everyday activities are consistently reported, and deemed attributable to focal changes in the bone, ligaments, cartilage and synovial tissues of the hand. The disease is not uniform though and is said to be a heterogeneous disorder with a multi-factorial etiology.

Although often underestimated as a cause of disability, the effect on quality of life from limitations in performing activities of daily living such as dressing and feeding may be considerable. The determinants of the magnitude of these are gender, radiological severity, duration of hand osteoarthritis, the presence of erosive joints, and its impact on pain, function, and stiffness. The presence of hand osteoarthritis may also be an important indicator of a systemic tendency to develop more generalized forms of the disease at other joints, which may involve weight bearing joints, notably the hips and knees. A definitive role for obesity in this regard has not been supported to date and would not explain unilateral hand joint osteoarthritis manifestations in the case of an overweight older person, however. Even if the disease does not spread for example if it is localized to the thumb base, the arthritis causes pain, loss of strength during pinch grips, and eventually stiffness and progressive deformity of the thumb column especially if intervention is delayed [19]. Osteoarthritis of the trapeziometacarpal joint similarly leads to a high degree of disease burden with compromises in rudimentary and fine movements of the hand, where intra-articular injections may be a desirable treatment option [20], as may denervation [21] and splinting [22] plus arthroscopic thumb base joint fusion [23] and topical diclofenac [24]. No recent work has established how biomechanical factors may drive the disease, and whether this is of import to evaluate and measure, especially in the long term, even if this could potentially explain the observed diversity of the disease presentation and its spread to other joints [25]. As per Kerkhof, et al. [26], the hand has a unique anatomical layout and structure that makes it possible to carefully manipulate tools, grasp objects, create and write with precision. However, daily forces or aberrant forces applied to the hand makes the hand susceptible to joint disorders such as osteoarthritis, over and above age and genetic factors [26]. Moreover, bone structure as well as anatomy may be impacted by biomechanical rather than hormonal or metabolic factors but is often not directly discussed or assessed prospectively [27], as may erosive hand osteoarthritis and sarcopenia [28, 29] plus inflammation and its mitigation that has failed to reduce long term hand symptoms from either a pharmacologic or exercise perspective [30-32], despite possible obesity and heightened cardiovascular risk [33, 34].

Although unreported or studied in 2024 we propose more attention be paid to the careful and isolated analyses of the most likely key hand associated influential biomechanical and motor correlates of key muscle groups at the hand that may influence risk and susceptibility to repeated bouts of vibration [35] such as:

- Subnormal muscle size/cross-sectional areas.
- Muscle fat infiltration.
- Muscle pathology and altered fiber type distribution ratios.
- Decrements in muscle reflexes,/coordination/force generation profiles.
- Muscle imbalances/co activation alterations.
- Muscle spindle and/or joint sensory deficiencies.
- Muscle inflammation and stiffness.
- Muscle endurance.
- Muscle inhibition.

We believe this will be time consuming but fruitful.

Discussion

Osteoarthritis, a chronic, highly prevalent and disabling disease and one expected to increase in prevalence secondary to longer life expectancy and a disproportionately large aging population remains an enormous challenge to avert and especially to treat effectively. Indeed, multiple forms of treatment to address pain accompanying this disease, as well as attempts to restore various degrees of

associated joint cartilage tissue damage, remain only marginal in impact despite decades of research. These approaches commonly including, but not limited to, weight control, exercise, non-steroidal anti-inflammatory drugs, acetaminophen, intra-articular steroids or viscosupplementation, topical analgesics, and joint replacement surgery, that appear to be applied regardless of joint site or its biomechanical origins where relevant remain suboptimal at best. Moreover, despite recognition of the need to meticulously examine sources of hand osteoarthritis as a basis for personalized based therapy, efforts to establish the origins of hand osteoarthritis have not uncovered anything definitive to date, although age, obesity, gender, and genetics are most commonly cited as determinants of the disease.

This appears to be somewhat helpful if one considers the need to address those at high risk, but does not explain or account for the presence of hand osteoarthritis of a single joint or multiple joints on one side of the body unrelated to handedness. There are also several reports in 2024 linking hand to knee osteoarthritis, but the common factor here is again not clear.

However, a reasonably understudied theme continues to be that of joint biomechanics along with aspects of motor dysfunction found in recent times in lower limb osteoarthritis, and suggesting a need to explore more intently how muscles at the hand may affect hand joint function and shock absorption. In this regard, even if one accepts that only positive studies are likely to be published, the data outlined briefly in 2023 [36] and representing a fair cross sectional of all studies conducted on or prior to that date and that sought to measure muscle associated factors in various hand osteoarthritis cohorts did show this line of inquiry is a possible highly valuable one. As stated then expanding this realm of inquiry to incorporate musculoskeletal modeling approaches, functional measures, imaging, and an array of established sensory-motor system measures may help to affirm that osteoarthritis is in fact not a disease of a single joint tissue alone, but is one that may originate or reside in the tissues supporting the joint, such as muscle and its control mechanism. As well, expanding upon this line of inquiry so as to examine muscle reflex responses, motor cortical associations, and muscle spindle features in hand osteoarthritis of different degrees that may prove highly insightful in calls for more dedicated efforts to develop comprehensive as well as more selective interventions to avert the spread of hand osteoarthritis joint pathology and its multiple disease ramifications.

In particular, how the adaptive changes in aging muscles as well as arthritic adaptations impact varying manifestations of hand osteoarthritis such as muscle mass quality and quantity declines, as well as possible slowing of one or more linkages of the sensory-motor system, must be considered vitally important to examine. Alternately, where these are not duly considered, or overlooked, stand alone or non tailored treatments may well be expected to fail over time, even if their short term basis is justified.

In short, predicated on what we now know about motor influences on knee joint and hip joint biomechanics and osteoarthritis, and on the basis of a fairly representative set of current supportive observations previously detailed [36], and the need for hand muscles to provide both mobility and stability, it seems reasonable to propose a possible explanatory as well as deterministic role for a variety of specific motor based impairments in advancing our disease understandings. Moreover, even a small advancement may mitigate much suffering, and permit or foster more selective, as well as efficacious intervention and disease mitigation approaches in the future.

As such, those who earnestly seek to alleviate the current and predicted future excess burden of hand osteoarthritis disability among the older adult population are encouraged to study and possibly uncover any consistent neuromotor feature that may be injurious to the aging hand or at least some who are suffering physical, social, and psychological impacts from their disabling hand osteoarthritis condition. While other avenues of endeavor are also encouraged, possible muscle functional attributes that may or may not be strictly reactionary in nature, may partially determine the mode of hand muscle adaptations and be amenable to intervention and possibly to prevent the disease from 'spreading' from one joint to another.

In the meantime, rates of osteoarthritis are increasing in many instances, and calls for more timely and insightful evaluations are being made consistently in the realm of osteoarthritis in general and joint biomechanics in particular.

Limitations

While not all 2024 or prior works may have been accessed in this mini report, and no quality assurance mechanism was conducted, those that were found relevant to examine were clearly diverse and represented a mixture of various types of hand osteoarthritis pathology, with differing inclusion and exclusion criteria, and were largely documenting surgery approaches in end stage disease rather than prevention. Moreover, most studies were short term in nature or systematic reviews of older studies with widely diverse assessment procedures and mostly reflect data from labs that may be well funded and able to reach cases with insurance or mobile cohorts rather than the population at large. Older adults unable to leave their homes as well as those with comorbid conditions may have been excluded from some studies almost none described the degree of disablement in daily tasks or how and at what stage an affected hand might weaken. It was equally challenging to ascertain what best practices are needed and why, because selected measurement procedures were rarely based on muscle based indicators, such as stiffness or pain, joint inflammation, muscle fat content and bone morphology as these along with diagnostic ultrasound and radiographic assays.

Future directions

To minimize the osteoarthritis burden, aging and employment influences on the extent of hand osteoarthritis pathology, plus the role of past and ongoing treatments, comorbid and motor system status should receive due consideration in the future in our view. As previously outlined, it also appears that when assessing the level of hand function in the growing older adult populations it is particularly important to acknowledge the hand's multidimensional functional nature and its related three key domains of strength, coordination, and sensorimotor processing status in those at highest risk or experienced degree of suffering. Moreover, efforts to distinguish among these functional domains and specific muscle based alterations in both men and women, and those with and without comorbid health conditions such as obesity and diabetes are desirable preventive treatment options to explore in our view. Patient education and understandings should be emphasized as well.

Key Conclusions

Although generally considered to have no distinct cause, most authors agree that hand osteoarthritis is a non uniform disease, albeit a highly disabling one with a variety of structural and functional correlates that does not affect all older people or those at risk uniformly. In retrospect, we conclude that the gaps in the literature as related to the interactive associations between the hand joints and muscles of the hand may partly explain the limited ability observed by many to lower hand osteoarthritis disability risk and the multiple manifestations of hand osteoarthritis pathology and its poor long term treatment response and often high rate of its progression and erosion of multiple hand joints in the older population.

In particular, based on some current arguments, it cannot be excluded that some forms of hand osteoarthritis may represent a predictable array of biomechanical responses that commonly emerge over an extended time period in the presence of one or more surrounding muscle abnormalities and that accounts for both its biochemical as well as cellular and molecular joint abnormalities, and possible more virulent erosive state in some cases.

Based on the majority of available clinical studies in this regard, it does appear moreover that considerable benefits at multiple levels are more likely than not to ensue for many if either the early muscle changes at vulnerable hand joints or those that are adaptive over time are clearly identified and treated accordingly. It may show what form of joint protection as well as what form of functional activities are safe and disability reducing.

However, non-specific grip strength measures or others used in isolation, a reliance on subjective pain scales, high end diagnostic tools that often require prolonged examination and processing, and a focus on strength training that does not account for fatigue or the actual sensory-motor deficits that may underlie the disease progression, may be expected to reduce the capability of the hand joint tissues to withstand stress during functional loading and dexterity attempts.

Alternately, it is concluded that careful evaluation and study of how the hand muscles and their neural pathways may impact one or more attributes of both early and late stage hand osteoarthritis pathology of a single as well as multiple joint sites, as well as unilateral versus bilateral joint diagnoses will improve our current understandings of the disease etiology and its pathogenesis, regardless of findings. As well, directives pertaining to how and when to best intervene to alleviate the multiple disabling life consequences found among the older adult population may be considerably improved.

Conflicts of interest

None.

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