

Gamification has the Potential to Improve Patient Engagement and Adherence in Physical Therapy

Justin B. Evans BS¹, Joshua Salisbury BS¹, Shali Schulz BS¹, Christopher Bacak MD MS¹, Alexis Sandler, MD¹, Nata Parnes, MD^{2,3}, John P. Scanaliato MD⁴, Benjamin Childs MD⁵

¹Texas Tech University Health Science Center, El Paso, TX, ²Carthage Area Hospital, Carthage, NY, ³Claxton Hepburn Medical Center, Ogdensburg, NY ⁴Rush University Hospital, Chicago IL, ⁵The Randolph Institute, Palm Beach FL

Objectives: The purpose of this study was to systematically investigate the primary outcomes of gamified physical therapy among orthopaedic surgery patients based on currently published literature.

Main outcome measurements: Any objective measures of functional improvement, participation or engagement.

Results: Search resulted in 419 articles regarding “gamification physical therapy orthopaedics,” of which 14 included measurement of gamification success. Post hoc analysis was completed on the 9 articles which included control groups showing no significant difference compared to standard physical therapy protocols.

Conclusion: There is no significant evidence found within the current literature to suggest that gamification has the potential to improve patient outcomes in physical therapy for orthopaedic patients when compared to conventional therapy. While some studies found and reported improved results among patients in a gamification cohort, the majority lacked any significant difference between the comparison groups. Additionally, a post hoc analysis did not support the argument that gamification may be as good as conventional therapy. However, it may still offer a viable alternative to conventional therapy in situations where an alternative is needed, or in situations of patient preference. Finally, due to the limited research comparing gamification to traditional therapy, further research is necessary to determine its optimal use and limitations.

Level of Evidence: Level IV, Systematic Review

Key Words: Orthopaedic surgery, post-op management, Gamification, Physical therapy

INTRODUCTION

Physical therapy is an essential aspect of postoperative recovery after orthopaedic surgery; however, conventional physical therapy methods can be perceived as monotonous and may lead to poor patient adherence and suboptimal outcomes.¹ To address this issue, researchers have explored the use of gamification to increase patient engagement and motivation during physical therapy.¹⁻¹⁴ Gamification involves using game design elements,

such as rewards and feedback, in non-game contexts.⁶ The purpose of this study is to compare the primary outcomes of conventional physical therapy compared to physical therapy with gamification methods for orthopaedic patients.

METHODS

This systematic review was performed in accordance with PRISMA guidelines for methodology and reporting. Eligibility criteria were determined by study design, types of comparisons, and outcome measures. Study designs included any cohort, trial, or case series. Types of interventions included any form of gamification of physical therapy for musculoskeletal conditions. Studies were included if a primary outcome of gamified physical therapy was reported. Studies were excluded if there was no primary outcome related to gamification, if the study design was focused on the specific game, or if the article was an editorial commentary.

Search was performed in Google Scholar via Harzing PoP software version 8¹⁵ for the following keywords: (gamification, physical therapy, orthopaedics). Results were not limited by year. All results were cataloged and independently reviewed by the authors.

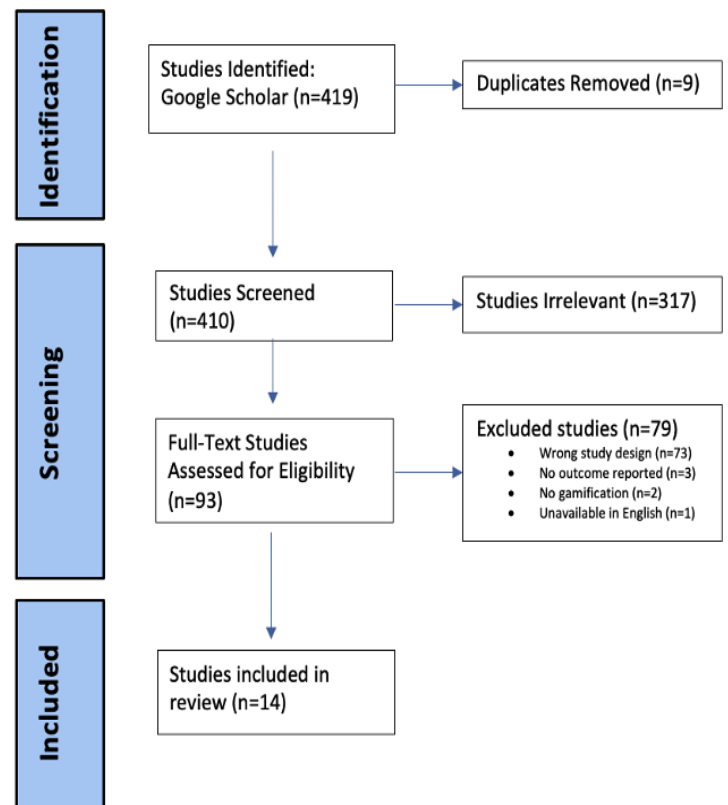
In the first phase, study titles and abstracts were screened by one author. For the second phase, the remaining articles' full texts were then reviewed in their entirety for those that met the inclusion criteria by two separate authors. Data including study characteristics, surgical interventions, primary outcomes, and corresponding results were then extracted from articles meeting inclusion criteria. The results were then further scrutinized by the authors and categorized into comparable labels divided between significant improvement, no significant difference, and improved results in the game group based on results and conclusions identified in the relevant manuscripts.

RESULTS

The search criteria yielded 419 articles including nine duplicates which were subsequently removed, resulting in 410 articles eligible for title and abstract screening. Of these articles, 317 were determined to be irrelevant and 93 were eligible for full-text review (Figure 1). Ultimately, 14 articles were determined eligible for inclusion in the present study. Of the remaining 14 studies, three were single-arm studies, two were case reports, and the remaining nine had control and intervention groups.

Outcome measures included: range of motion, hip disability and osteoarthritis outcome score, desirable features to include in exercise games, grip strength, timed up and go, system usability scale score, PROMIS, overall score of physical function, knee extension torque, knee proprioception, and adherence.

Figure 1: PRISMA flow diagram of studies from search through screening to inclusion and exclusion



Of the three single-arm studies, two were qualitative and described significant improvement among the participants. One was a qualitative study that identified demonstrations, motivational components, and convenience as the most important characteristics among participants. The two case studies also saw significant improvement with gamification techniques.

In the nine studies involving two groups, five found no significant difference between the two interventions and four reported improved findings among the gamification groups. Studies reported no significant difference between the interventions that underwent surgical interventions including arthroscopic subacromial decompression, total knee arthroplasty, arthroscopic ankle arthrodesis, arthroscopic shoulder surgery, and flexor tendon

repair. Those that reported a difference between the two groups had undergone total knee arthroplasty or no surgery as seen in Gruner et al., Krepkovich et al., and Sadeghi et al.^{5,8,12} Two of these studies had non-operative knee conditions and one was conducted on healthy elderly men.

Of the studies in which the participants had undergone operative management, five found no significant difference between gamified and non-gamified interventions while one did report improved outcomes in the gamification subgroup.

There were nine studies that were eligible for post hoc analysis. Seven of these were found to have a power less than 0.80 in this post hoc analysis. One of the remaining studies had a power of 100% and reported improved knee proprioception within the game group. The last article had a power of 99.8% and reported no significant difference in range of motion.

DISCUSSION

After analyzing the fourteen articles found in this literature review, it was discovered that gamification has the potential to improve patient engagement and adherence in physical therapy among selected groups of orthopaedic patients. Out of the fourteen studies, five did not compare gamification to conventional physical therapy methods and these studies concluded apparent improvements in patient primary outcomes. This may indicate that gamification has the potential to improve physical therapy outcomes in orthopaedic patients.

Of the nine studies comparing gamification to conventional physical therapy methods, four

studies reported better results in the gamification group. However, it is important to note that three of these studies were conducted in non-operative conditions, such as chronic musculoskeletal pain, and therefore may not be generalizable to the orthopaedic surgical population. The remaining five studies did not show any significant difference between gamification and conventional physical therapy methods. While this can be interpreted as a limitation of gamification, it can also be viewed as a positive outcome: if gamification can achieve the same results as conventional physical therapy methods, it provides a viable alternative that can improve patient engagement and satisfaction. However, post hoc analysis did not distinctly support this argument.

Within the current literature, one review article investigated biofeedback systems and concluded that they should be considered as an alternative therapy. Among the ten articles included in their study, only two had a control group and five were conducted among a healthy cohort.¹⁴ These findings align with previous reports. In a review focused on virtual reality, Agresta et al. concluded that although there is limited data in support of its effectiveness, gamification may serve as a viable alternative.¹⁶ This aligns with findings in the present study, which suggest that gamification is similarly effective, though not superior, to conventional therapy. This may be particularly beneficial for patients who face geographical or financial barriers to treatment, potentially leading to improved outcomes in selected groups of patients.

Factors such as patients' perceptions of their injuries and ability to recover are important to consider among efforts to enhance patient rehabilitation, as they may impact adherence to physical therapy.¹³ Patient adherence to the recovery program can be improved by introducing methods that increase motivation and prevent them from becoming overwhelmed by their injury. A survey conducted with patients revealed that gamified therapy, which is more interactive, convenient, and motivational, ultimately increased participation desirability. Patients also suggested that game therapy designers make the games more social with added reminders and rewards to further enhance the overall experience.¹⁰ In summary, patients prefer physical therapy exercises that are more enjoyable and interactive.

In most cases, gamification techniques in physical therapy involve the use of advanced technology equipment to quantify and monitor movement and strength. This ability to quantify new components of movement adds to the potential for improvements within self-motivated patients participating in gamification.⁹ Therefore, the integration of technology with gamification can lead to better tracking and monitoring of patient progress, allowing healthcare professionals to provide more targeted and personalized interventions.

Overall, the findings of this literature review suggest that research regarding gamification success is limited, especially as compared to non-gamified therapy. However, existing literature suggests that gamification has the potential to improve physical

therapy outcomes in orthopaedic surgery patients. While some studies showed better results in the gamification group, the lack of significant difference in other studies suggests that gamification may not be more effective than conventional physical therapy methods.

Limitations of this study involve a lack of a standardized measurement regarding gauging the success of gamification among participants. Few articles were found that measured the same outcomes and the interpretation of their results depended largely upon the article's conclusions. Additionally, by nature of a systematic review, data collected were limited to the heterogeneous results collected among existing studies. For this reason, a meta-analysis was not performed. As gamification is a relatively new approach to physical therapy, further research is needed to determine its optimal use and potential limitations.

CONCLUSION

There is no significant evidence found within the current literature to suggest that gamification has the potential to improve patient outcomes in physical therapy for orthopaedic patients when compared to conventional therapy. While some studies found and reported improved results among patients in a gamification cohort, the majority lacked any significant difference between the two groups. Additionally, a post hoc analysis did not support the argument that gamification may be as good as conventional therapy. However, it may still offer a viable alternative to conventional therapy in situations where an alternative is needed, or in situations of self-motivated patient preference.

Finally, due to the limited research comparing gamification to traditional therapy, further research is necessary to determine its optimal use and limitations.

REFERENCES

1. Barratt AE. *Gamification for Activation Motivation and Engagement (Doctoral dissertation, University of Salford (United Kingdom))*.
2. Arrebola LS, Yi LC, de Oliveira VG. *The use of video games combined with conventional physical therapy in children with upper limb fractures: an exploratory study. Journal of Pediatric Rehabilitation Medicine. 2019 Jan 1;12(1):65-70.*
3. Carmichael JP. *Novel Approaches in Rehabilitation after Total Knee Arthroplasty (Doctoral dissertation, University of Colorado Denver, Anschutz Medical Campus)*.
4. Correia FD, Nogueira A, Magalhães I, Guimarães J, Moreira M, Barradas I, Teixeira L, Tulha J, Seabra R, Lains J, Bento V. *Home-based rehabilitation with a novel digital biofeedback system versus conventional in-person rehabilitation after total knee replacement: a feasibility study. Scientific reports. 2018 Jul 26;8(1):1-2.*
5. Gruner MP, Hogaboom N, Hasley I, Hoffman J, Gonzalez-Carta K, Cheville AL, Li Z, Sellon JL. *Prospective, single-blind, randomized controlled trial to evaluate the effectiveness of a digital exercise therapy application compared with conventional physical therapy for the treatment of nonoperative knee conditions. Archives of Rehabilitation Research and Clinical Translation. 2021 Dec 1;3(4):100151.*
6. Hendrickx R, van der Avoird T, Pilot P, Kerkhoffs G, Schotanus M. *Exergaming as a Functional Test Battery in Patients Who Received Arthroscopic Ankle Arthrodesis: Cross-sectional Pilot Study. JMIR rehabilitation and assistive technologies. 2021 May 5;8(2):e21924.*
7. Janela D, Costa F, Areias AC, Molinos M, Moulder RG, Lains J, Bento V, Scheer JK, Yanamadala V, Cohen SP, Correia FD. *Digital Care Programs for Chronic Hip Pain: A Prospective Longitudinal Cohort Study. InHealthcare 2022 Aug 22 (Vol. 10, No. 8, p. 1595). MDPI.*
8. Krepkovich E, Kaur M, Mangum LC, Saliba S, Lichter M, Olowin A, Richardson N, Hart J. *Feasibility of a Novel Video Game-Based Electromyography Biofeedback System in Patients With Knee Osteoarthritis. Journal of sport rehabilitation. 2022 Jun 10;31(7):937-42.*
9. Marley WD, Barratt A, Pigott T, Granat M, Wilson JD, Roy B. *A multicenter randomized controlled trial comparing gamification with remote monitoring against standard rehabilitation for patients after arthroscopic shoulder surgery. Journal of Shoulder and Elbow Surgery. 2022 Jan 1;31(1):8-16.*
10. McClincy M, Seabol LG, Riffitts M, Ruh E, Novak NE, Wasilko R, Hamm ME, Bell KM. *Perspectives on the Gamification of an Interactive Health Technology for Postoperative Rehabilitation of Pediatric Anterior Cruciate Ligament Reconstruction: User-Centered Design Approach. JMIR Serious Games. 2021 Aug 27;9(3):e27195.*
11. Naqvi WM. *Gamification in therapeutic rehabilitation of distal radial and ulnar fracture: a case report. Cureus. 2022 Aug 30;14(8).*
12. Sadeghi H, Hakim MN, Hamid TA, Amri SB, Razeghi M, Farazdaghi M, Shakoor E. *The effect of exergaming on knee proprioception in older men: A randomized controlled trial. Archives of gerontology and geriatrics. 2017 Mar 1;69:144-50.*
13. Svingen J. *Flexor tendon repair: rehabilitation adherence, outcome and complications.*
14. Zago NN, de Souza LA, Kimura BG, Bertencello D, Grecco MA, Fernandes LF. *Serious games therapy associated with conventional physical therapy intervention accelerated hand muscles strengthening and hand functioning after complex fracture of the wrist: A case report. Journal of Hand Therapy. 2020 Oct 1;33(4):580-6.*
15. Harzing, A.W. (2007) *Publish or Perish*, available from <https://harzing.com/resources/publish-or-perish>
16. Agresta C, Brown A. *Gait retraining for injured and healthy runners using augmented feedback: a systematic literature review. journal of orthopaedic & sports physical therapy. 2015 Aug;45(8):576-84.*