Research Paper

Pain-induced Impact on Movement: Motor Coordination Variability and Accuracy-based Skill

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ABSTRACT

Introduction: Studies on pain are generally conducted for two purposes: first, to study patients with pain who have physical changes due to nerve and muscle lesions, and second, to regain the appropriate kinematic post-pain pattern. The present study aimed to investigate the effect of pain on the coordination variability pattern and throwing accuracy.

Methods: The study participants included 30 people aged 18-25 years who volunteered to participate in the study. Participants practiced and acquired skills in 10 blocks of 15 trials. In the test phase associated with pain, Individuals were randomly divided into three groups: local pain, remote pain, and control. In their respective groups, participants were tested in a 15-block trial, 24 hours, and 1 week after acquisition.

Results: The results revealed that pain did not affect the throwing accuracy (P=0.456). Besides, in the phase of acceleration in throwing, movement variability in the pain-related groups in the shoulder and elbow joints (P=0.518), elbow and wrist (P=0.399), and the deceleration and dart drop phase movement variability in the pain-related groups in the shoulder and elbow joints (P=0.622), elbow and wrist (P=0.534).

Conclusion: Based on the results, the accuracy and coordination variability in pain-related groups were similar. However, to confirm these results, more research is needed on performing motor functions in the presence of pain.

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Highlights

- Pain are generally conducted for two purposes.
- pain which has physical changes due to nerve and muscle lesions and pain to regain the appropriate kinematic post-pain pattern.
- People who experience pain show poor motor results.
- Pain restriction is ordinary in joints and the body compensates by increasing movement.

Plain Language Summary

One of the constant concerns of sports science experts is to find ways to improve performance or to know the factors that strengthen or weaken motor learning. After injury, pain has been described as one of the passive symptoms, and the mechanism of how overexertion of joints and muscles increases injury and pain is unknown. Following any injury, pain is one of the most important causes of disability and one of the most important problems in people's general health. Many treated individuals present with pain and impaired movement, and typically changes in movement control are a result of the pain. Research evidence suggests that pain induces changes in cortical excitability and the neuroplasticity model that accompanies practice of a new motor task interferes with the performance improvement that must occur simultaneously. According to the new approaches of motor and biomechanical learning and control, movement variability, especially in movement coordination, is considered as an important and influential factor of a person with different conditions. Novice athletes show high non-functional variability in order to reduce the degrees of freedom and then simplify their motor task, in contrast to skilled people, they display functional variability that allows them to perform a motor task better. in variable conditions. Scientists and researchers have concluded that in the presence of pain, there are changes in the pattern requirements and muscle coordination. Clearly, variability is a main feature of most neurological and musculoskeletal pains, and it is necessary for therapists to diagnose and classify incomplete movements and to effectively manage symptoms by controlling incomplete movements, so conducting such research in this field in order to show muscle and movement changes It is necessary under the influence of pain

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1. Introduction

Individuals who experience pain show poor motor results and have also been shown to have a more limited ability to learn motor patterns (Jönsson, Lindgren, Hallström, Norrving, & Lindgren, 2006). Human and animal studies have shown that pain can affect motor pathways (Busch, Barber, K. Overend, Peloso, & Schachter, 2007), and researchers have found that pain can reduce contractile volume, reduce muscular endurance, and alter motor coordination during dynamic motor tasks (Sewards, & Sewards, 2002; Price, 2000; Vogt, Sikes, 2000). Studies have demonstrated that spinal cortical inhibition in the presence of pain may interfere with normal and immediate muscle function, and this event may impair the motor cortical plasticity potential (Volz, Suarez-Contreras, Mendonca, Pinheiro, Merabet, & Fregni, 2013). Most individuals' performance, such as speed and accuracy, is affected by pain, and pain adaptation involves changes in several levels of the somatosensory system (Hodges & Tucker, 2011).

Studies on pain are generally carried out for two purposes: first, to study patients with pain who have physical changes due to nerve and muscle lesions, and second, to regain the appropriate kinematic pattern after pain (Bouffard, Bouyer, Roy, & Mercier, 2014). Different theories have suggested responses and adaptations to pain, but in general, there are different patterns for adapting to pain and empirical responses to pain that differ from one person to another and from one task to another. Research observations show that muscles change the way they produce energy and the strategy of movement instead of inhibiting activity (Hodges & Tucker, 2011). Pain-adaptation theory has shown these changes as redistribution of intramuscular activity, motor mechanisms, movement modification, muscle contraction, and pain and injury protection mechanisms (Hodges & Tucker, 2011) The argument is that in the presence of pain, the active units change and lead to changes in muscle strength and muscle movement direction (Hodges & Tucker, 2011). Since the pain restriction is ordinarily joint, the body compensates by increasing movement in other body parts (Comerford, Mottram, 2012).

The central nervous system (CNS) has different strategies for performing each functional task, and ideally, the CNS selects the most appropriate and least risky strategy for pain by coordinating the synergies of an organ or general pattern (Hodges, Moseley, 2003). Variability is a significant feature of most neuropathic and musculoskeletal pain and is essential in diagnosing and classifying imperfect movements for therapists and effectively monitoring symptoms by controlling incomplete movements (Bergin, Tucker, Vicenzino, van den Hoorn, W., & Hodges, 2014). Bergin (2016) suggests that reducing variability during acute pain in a short time may help achieve the safety goals of the nervous and motor systems, but maintaining it, in the long run, may interfere with the complete and correct execution of the movement (Bergin, 2016). Therefore, it is necessary to conduct such research to show the muscular and motor changes under the influence of pain and learning of skills. Ultimately, this research could develop practical exercises to recover from the pain and obtain an appropriate movement pattern.

There are conflicting results in studies of variability in acute and chronic pain. Moseley, & Hodges (2006) and Madeleine, Mathiassen, & Arendt-Nielsen (2008) (Hamill, van Emmerik, Heiderscheit, & Li, 1999, Yakhdani, et al. 2010, Cunningham, et al. 2014) reported that variability increases when there is acute pain, while some researchers have stated that variability decreases during chronic pain (Hamill, et al. 1999, Yakhdani, et al. 2010, Cunningham, et al. 2014). However, when there is chronic pain due to adaptability, the variability that increases at the beginning of the movement may decrease with continued movement and exercise. In acute pain in individuals due to incompatibility, variability faces a steady decline or increase (Bergin, 2016).

Besides, researchers have stated that the variability in the motor system depends on the location and pain (Dancey, Murphy, Andrew, & Yielder, 2016). Depending on the pain's location, there are conflicting results in reducing or increasing variability in the movement system (Dancey, et al., 2016). This reduction in variability is likely due to a reduction in error and control of damaged joints and organs (Côté, Raymond, R., Mathieu, Feldman, & Levin, 2005). On the other hand, depending on the pain location and the type of task, the motor system may use another strategy that combines reducing the variability in the affected limb and increasing the variability in the parts of the body that are painless (Bergin, 2016). In this context, increasing variability may be a strategy to compensate for less movement in painful limbs and joints and maintain the overall movement pattern (Van Dillen, Maluf, & Sahrmann, 2009). Studies have shown that people with pain variability reduce their coordination, and the strategy to reduce pain can increase pressure on an area and muscle pressure and lead to new injury (Yen, Gutierrez, Ling, Magill, & McDonough, 2012). It is assumed that due to a change in activity or avoidance of pain response, the variability in movement decreases in the face of painful stimuli (Hafer, Brown, & Boyer, 2017). This reduction in variability indicates a decrease in the motor system's flexibility, in which people use less common patterns and movement sections to produce movements (Newell, 1985). Less use of movement patterns and fewer moving parts in coordination variability in people who experienced pain may indicate that people are trying to avoid pain or cannot obtain a full range of motion patterns due to pain and injury (Latash, Scholz, & Schöner, 2002). In injured people or those with a history of injury, the variability of coordination changes over a short period due to excessive pressure on using a pattern and muscle fatigue (Lamoth, Meijer, Daffertshofer, Wuisman, & Beek, 2005).

In the presence of less pain, individuals can integrate the relationship between stages or the coordination of body parts (Seay. Van Emmerik, & Hamill, 2011). Lamoth et al. (2005) showed that people with low back pain (LBP) symptoms showed a significant reduction in the coordination variability and then in the trunk and hip joint (Lamoth, et al., 2005). Another study comparing healthy and painful people's patterns of coordination showed that in healthy people, during walking and rotation, the pelvic oscillation and in the middle of the way, the body rotates in the opposite direction, and in the final stage, the joints rotate in one direction (Seay, et al., 2011). However, in individuals with pain, this distinction between limbs could not be observed, which may be due to increased stiffness of the trunk muscles and decreased coordination (Meulders, Jans, & Vlaeyen, 2015). These changes are helpful in interrelated and ongoing stages and are used to differentiate between healthy and pain-experienced individuals associated with reduced variability in people with pain (Hamill, et al. 2012).

However, previous studies have provided crucial information and insights about variability and execution accuracy in the presence of pain. Nevertheless, gaining a profound understanding of this and helping clinical rehabilitation in people with pain while still moving requires their study. It shows that despite acute pain, there are changes in the pattern of motor coordination diversity. Therefore, this study aimed to investigate the effects of pain on skill performance in people who have learned this skill.

2. Participants and Methods

Study participants

Thirty men aged 18-25 years who were all right-handed and had no knowledge of dart-throwing skills volunteered to participate in the present study. After giving the initial instructions, the participants practiced darts throwing in 10 blocks of 15 trials. Participants were randomly divided into three groups in the test phase: local pain, remote pain, and control. The inclusion criteria for this study were as follows: right-handedness, no history of illness, not being an athlete, no education in sports sciences, no experience in dart-throwing, and no experience of acute and chronic pain with a scale of seven on the right hand and right foot. All participants were homogenized in terms of age, level of education, geographic area of life, height, and weight. Also, all experiments were approved by the Research and Ethics Committee of Shahid Beheshti University (IR.SBU.ICBS.97/1046), Tehran, Iran.

Data collection tools

Throwing accuracy was measured using the dartboard and the participants' scores during the two acquisition and retention phases. In the present study, the ordinary circular-shaped dartboard made of compressed paper, with a diameter of 159 mm and a thickness of 12 mm, and for throwing the backboard of the dartboard, which numbered from zero to ten, was used. According to the World Darts Federation instructions, the dartboard is mounted with the center of the bullseye at the height of 1.73 m from the floor in the laboratory. A line was drawn on the floor at a distance of 2.37 m from the dartboard. The subjects' feet were behind the throw line at the throwing time. Fifteen metal darts tips with a 25g weight and a 15cm length for throwing were used.

Human motion analysis machine

An American-made motion analysis model was used to record the kinematic motions. Eight infrared cameras power this motion picture camera at 240 frames per second. Cortex software was also used to analyze motions. To obtain accurate and noise-free data, the test environment must be calibrated. For this purpose, after arranging the cameras and adjusting the height and field of view according to the volume of the test environment and the participants' height, first the static caliber and then the dynamic caliber were performed. After 3D calibration (static and dynamic), the spatial accuracy of the system should be less than 0.03 mm. At this point, after defining and naming the markers, as well as specifying the time of movement, the video recording phase began.

Markers

The peculiarities of specific body parts must be specified to achieve the kinematic characteristics of movements using an imaging device. To this end, spherical light-reflecting markers are mounted on the bony prominence limbs, which are often equivalent to or close to the joint axis of movement. Eleven markers on participants' bodies include the right acromion, the middle part of the humerus, lateral and medial humeral epicondyles, the forearm, radial, and ulnar styloid processes, middle of the third metacarpi, the distal extremity of the second and fifth metacarpi. A marker is attached as a reference in the trunk area beneath the prominence of the last rib cage.

Movement coordination variability

Various methods have been devised for quantifying coordination. In the present study, the vector coding method is used to measure coordination variability due to the tasks and assumptions. Vector coding techniques have been introduced to the data in relative motion plots and the variability in angle-angle trajectories (Davids, Bennett, & Newell, 2006). These techniques stem from the early work of Freeman, who devised a chain-encoding technique to quantify an angle-angle curve (Heiderscheit, Hamill, & Caldwell, 2000).

Visual Analog Scale (VAS)

A Visual Analog Scale (VAS) is the pain measurement instrument scaled from zero to ten, which includes a horizontal line ranging from zero to ten in which zero indicates "no pain at all" and ten represents "pain as bad as it could be" (Parsay, Olfati, & Nahidi, 2009). Capsaicin 1% gel was used to induce pain, containing red pepper and stimulating free nerve endings and pain receptors.

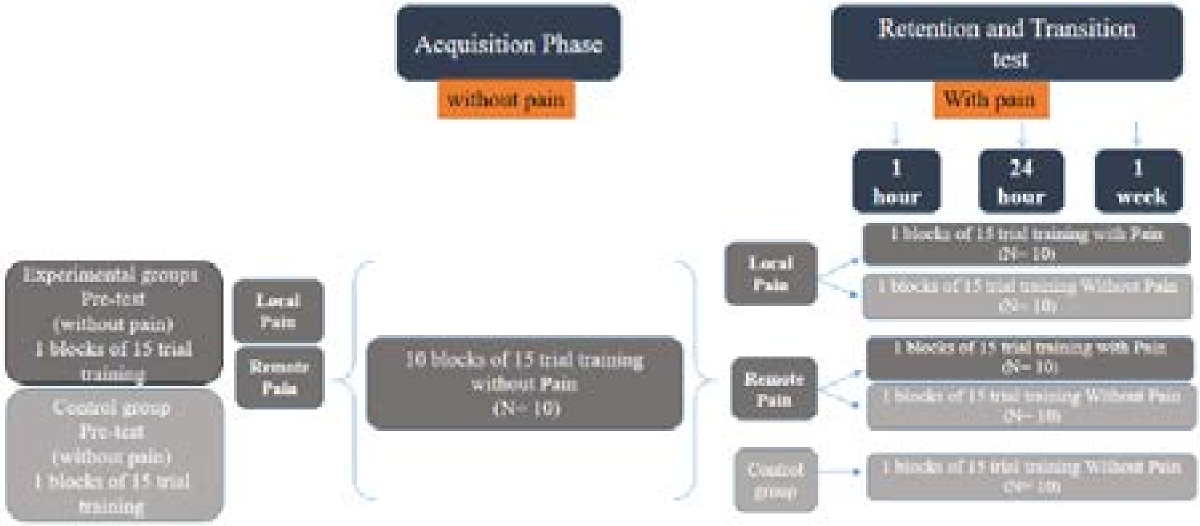

Figure. 1. Experimental Design

Implementation procedures

Participants were selected from healthy individuals with no history of illness and muscle pain and no experience in dart-throwing. All participants were volunteers, and informed consent was given for applying the pain. In this test, the application of pain in the test phase was meant to investigate the effect of pain on the coordination pattern variability of a task and movement accuracy. Before conducting the research, participants were asked to perform 15 throwing trials as a baseline and a pretest. In the implementation phase, the participants were first introduced to the basic principles of dart-throwing skills, such as the way of the gripping dart and how to score. The researcher then demonstrated the dart-throwing skill pattern to all participants in each group three times. Individuals performed the movement during 15 throws, considered a basic level and a pretest for individuals.

The participants practiced and acquired skills in 10 blocks of 15 attempts without pain in the acquisition phase. They were placed on the launch line after a 5-minute warm-up phase and began throwing. At each stage, five darts were thrown, and the participants rested for 1 minute while collecting arrows from the dartboard. After performing the pretest and practicing 150 trials, they were evaluated in two phases of tests, including 24-hour, and 1-week.

In local pain, capsaicin gel is applied to the outer side of the elbow at 5 cm; in remote pain, capsaicin gel to the upper area of the knee joint is five cm. The amount of pain was measured using the VAS scale. Movements in pain groups were performed when individuals reported the severity of their pain perception of seven. The pain-free control group was evaluated in all trial and retention tests (Figure 1).

Motion phases

Dart-throwing motion consists of four phases: aiming, take-back, acceleration, and deceleration and release. The aiming phase involves focusing on the target, which will continue with the backward movement of the elbow that performs the elbow flexion motion. At the end of this phase, the velocity of the limb and elbow joint becomes zero. The onset of the acceleration phase is associated with a reversal from flexion to elbow extension. At the end of this phase, the hand reaches the deceleration and release phase. In the present study, motion analysis focuses on the acceleration, deceleration, and dart release phase (flexion to elbow extension).

Data collection

To record accurate and noise-free data, the test environment must be calibrated. For this purpose, the system's spatial accuracy must be less than 0.03 mm, and a 10-Hz double-sided Butterworth filter was used to cut and divide the frequencies into three to smooth the data. After processing operations in Cortex software, the data are extracted to calculate kinematic variables in Excel format. In this study, maximum wrist flexion range, maximum elbow extension range, shoulder angular displacement range, angular throw velocity, and throw duration are considered pattern kinematic variables. The joint motion range was considered the difference between each joint's maximal flexion and maximal extension. Throw time was calculated by the difference between the moment of movement start (maximum elbow flexion) and the moment of movement end (maximum elbow extension). The angular velocity of the throw was also obtained by dividing the angular displacement range of the elbow by the throw time.

3. Results

The present study aimed to investigate the effects of pain in two phases of the combined analysis of variance tests (2×3). The Shapiro–Wilk test for normality of the data and Levene's test for variance equality were also used. During skill acquisition, pain intensity was not significantly different between the two groups (P=0.783; Supplementary Table 1).

Throwing accuracy

The combined variance analysis test (2×3) indicated no difference in throwing accuracy between people with pain and without pain, and the main effect of the group (F=0.797, P=0.456, eta=0.029) was not significant. Also, over time, there was no difference between the groups in throwing accuracy, and the main effect of the measurement steps (F=0.244, P=0.623, eta=0.005) was not significant. In addition, the interactive effect of group and evaluation steps (F=1.189, P=0.312, eta=0.042) is not significant (Figure 2).

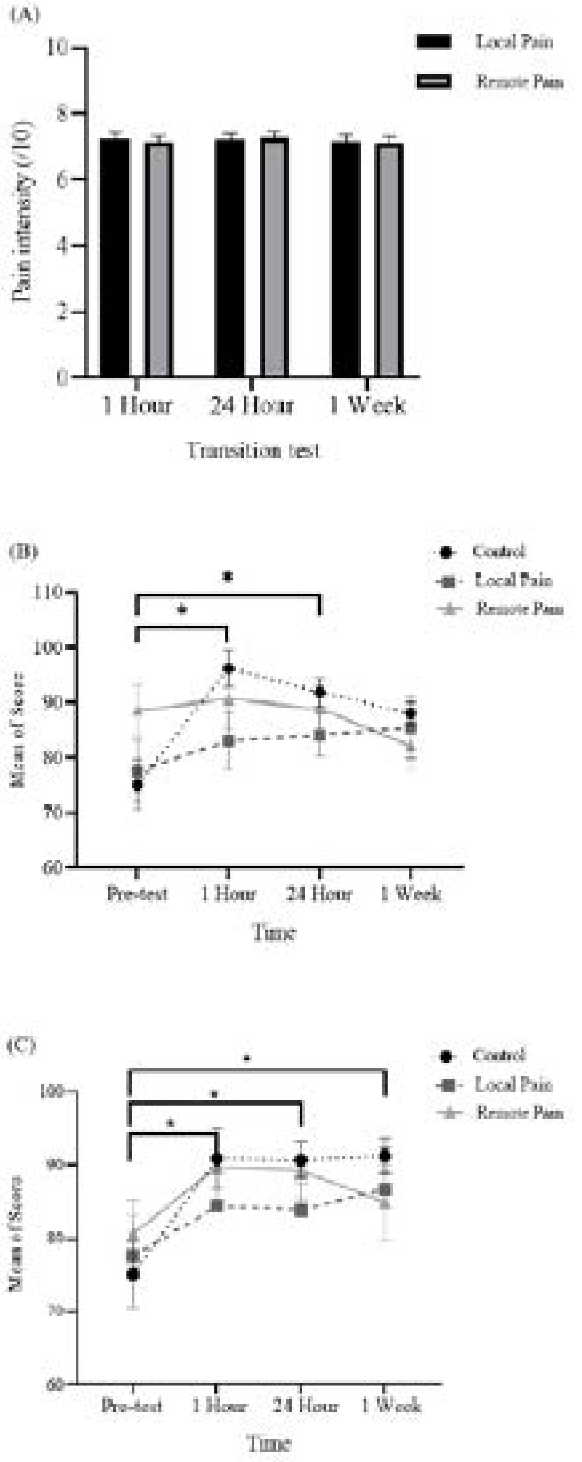

Figure. 2. In Two Tests, Mean Dart-Throwing Accuracy Scores in Three Groups of Localized Pain, Remote Pain, and Control

Black circle with dot marker, average throw accuracy score in the control group, square with stripe, throw accuracy in local pain group, a gray triangle with a line, average accuracy in remote pain group

Coordination pattern variability

Acceleration phase

The combined variance analysis test (2×3) for shoulder-elbow coordination pattern variability showed that individuals with local and remote pain and pain-free did not differ in the two phases of the test (F=0.666, P=0.518, eta=0.025). Also, by examining the evaluation phases (F=1.074, P=0.305, eta=0.020) and the interactive effect of the group and the evaluation phases (F=0.468, P=0.629, eta=0.018), the results showed that the statistical difference was not significant (Figure 3).

The combined variance analysis test (2×3) showed that the coordination pattern variability of the elbow wrist in the three groups was not statistically significant (F=0.936, P=0.399, eta=0.035). In evaluation phases (F=1.211, P=0.276, eta=0.023), and also due to group interaction and evaluation steps (F=0.986, P=0.380, eta=0.037) no significant statistical difference was observed (Figure 4).

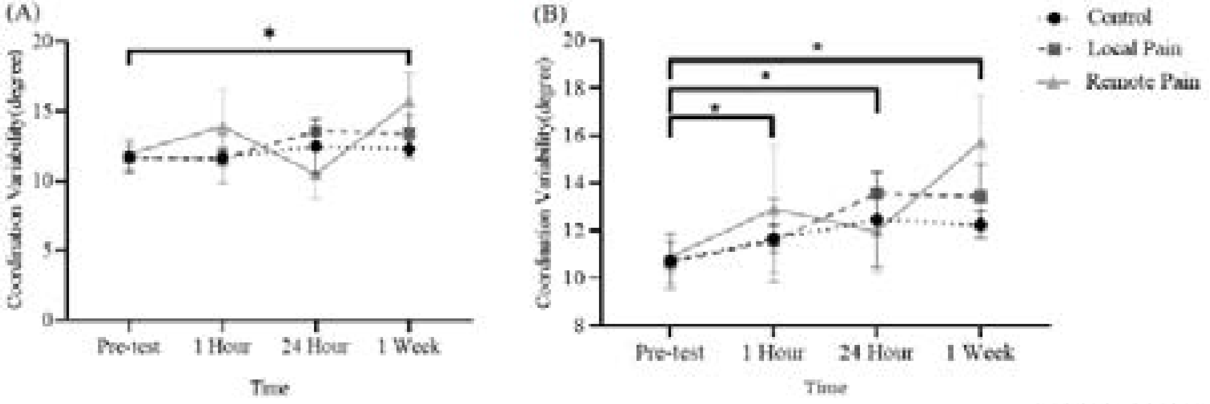

Figure. 3. Mean Score of Coordination Variability of Shoulder to Elbow in Acceleration Phase in Three Groups of Localized Pain, Remote Pain, and Control in Two Tests

Black circle with dot marker, average throw accuracy score in the control group, square with stripe, throw accuracy in local pain group, a gray triangle with a line, average accuracy in remote pain group.

Deceleration and dart drop phase

The combined variance analysis test (2×3) for shoulder-elbow coordination pattern variability showed that individuals with local and remote pain and pain-free did not differ in the two phases of the test (F=0.479, P=0.622, eta=0.018). In the evaluation phases in all three groups, a statistically significant difference was not observed over time between people with local and remote pain and control groups (F=0.546, P=0.463, eta=0.010) and the interactive effect of the group and evaluation phases (F=35.146, P=0.245, eta=0.575) were significant (Figure 5).

The combined variance analysis test (2×3) showed that the coordination pattern variability of the elbow wrist in the three groups was not statistically significant (F=0.635, P=0.534, eta=0.024). In addition, in the evaluation phases (F=0.056, P=0.814, eta=0.001) were not significant, and the interactive effect of the group and evaluation phases (F=24.073, P=0.321, eta=0.481) were not significant (Figure 6).

4. Discussion

The present study investigated the impact of pain on the accuracy and the coordination variability pattern in dart tasks. In this study, we compared pretest scores and the last acquisition practice block to ensure that all individuals learned the skill well and that the results confirmed that. The results revealed that the pain did not affect the throwing accuracy and coordination variability pattern in the deceleration and dart drop phases.

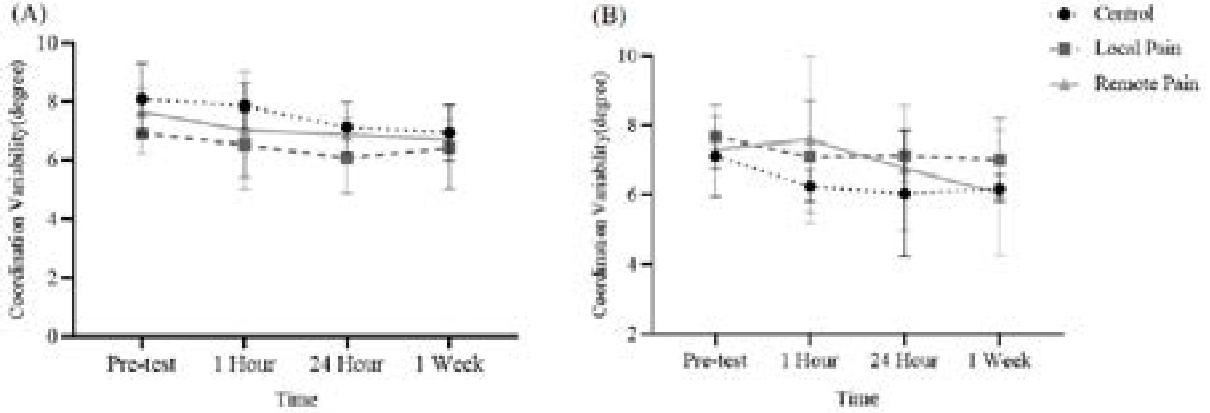

Figure. 4. Mean Score of Coordination Variability of Elbow to the Wrist in the Acceleration Phase, in Three Groups of Localized Pain, Remote Pain, and Control, in Two Tests

Black circle with dot marker, average throw accuracy score in the control group, square with stripe, throw accuracy in local pain group, a gray triangle with a line, average accuracy in remote pain group.

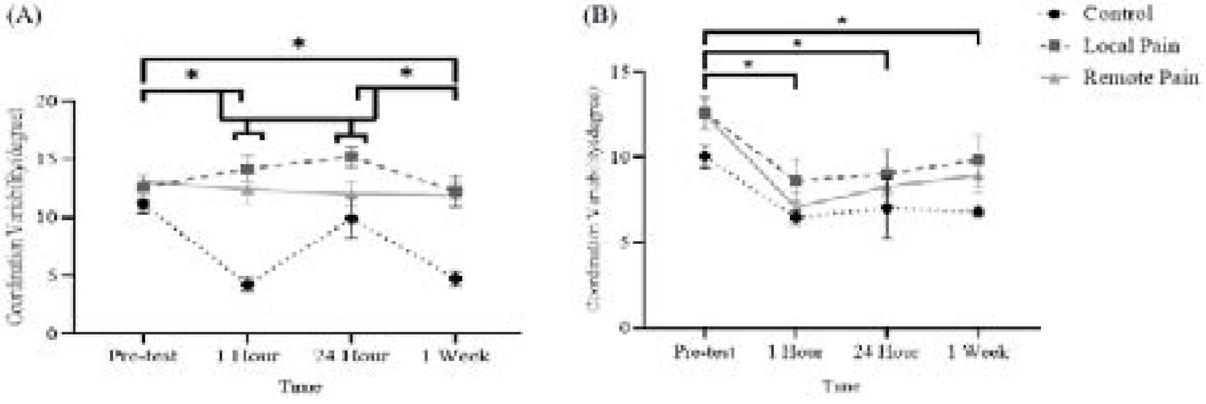

Figure. 5. Mean Score of Coordination Variability of Shoulder to Elbow In Deceleration and Dart Drop Phase, in Three Groups of Localized Pain, Remote Pain, and Control, in Two Tests

Black circle with dot marker, average throw accuracy score in the control group, square with stripe, throw accuracy in local pain group, a gray triangle with a line, average accuracy in remote pain group.

In general, the pain did not affect individuals' overall performance. Pain-related research in the retention period evaluates the central nervous system's adaptability and strengthens the movement pattern. However, according to the results of Bouffard (2014), adaptation to pain causes changes in retention and transition skills. Accordingly, it can be stated that each person can use a unique strategy during the stage of adaptation to pain depending on the level of pain perception and endurance of individuals, while the goal of the movement is the same for all individuals (Bouffard, et al., 2014). Also, depending on the location and type of pain, people can use more or less various parts of their limbs, leading to an increase or decrease in the variability (Madeleine, et al., 2008). When using complex and multi-joint tasks in the presence of pain, the nervous system tries to reduce pain by using a solution and variable options in the limbs to perform the motor function, which may increase motor function (Moseley, Hodges, 2006).

The present study results show that in individuals with pain in their coordination variability, the accuracy of throwing and achieving the goal of movement in these people was not different from painless individuals. These results are consistent with Ingham's study, which found that people achieved their goal of movement despite the pain (Ingham, Tucker, Tsao, & Hodges، 2011). However, some studies have shown a lack of overall goal achievement in persons with pain (Smith, Kulig, 2016, Ebrahimi, et al., 2017), which is inconsistent with the results of the present study and seems to be due to the use of different tasks.

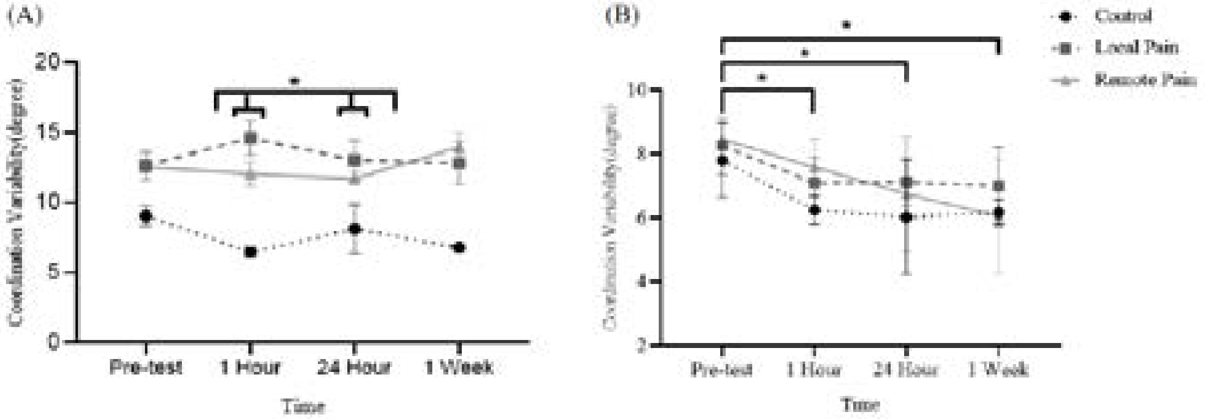

Figure. 6. In Two Tests, the Mean Score of Coordination Variability of Elbow to the Wrist in Deceleration and Dart Drop Phase, in Three Groups of Localized Pain, Remote Pain, and Control

Black circle with dot marker, average throw accuracy score in the control group, square with stripe, throw accuracy in local pain group, a gray triangle with a line, average accuracy in remote pain group.

Table 1. Comparison of pain intensity

	Local pain group	Remote pain group
N	10	10
Vas (Mean)	7.20 ± 0.02	7.17 ± 0.08
Std. Deviation	0.09278	0.11764
t	1.384	
P	0.783	
F	0.099	

On the other hand, some studies have shown that the type of pain is also helpful in increasing or decreasing the individuals' coordination variability (Salomoni, Graven-Nielsen, 2012). Hamill (1999) and Heiderscheit, Hamill, & van Emmerik (2002) reported that people with chronic pain decrease the movement pattern variability to eliminate pain (Hamill, et al., 1999, Heiderscheit, et al., 2002). However, in people with acute pain, the nervous system at the beginning of the movement increases the variability of the main components of the motion, decreases these components, increases the use, and consequently, the variability in the non-primary motion (Bergin, et al. 2014). Furthermore, the present study results did not align with the study of Moseley and Hodges, in which initially, the coordination variability increased, and the variability in the central organ of movement decreased (Moseley, Hodges, 2006).

According to Bergin's research, pain can lead to the overuse of unnecessary organs, which increases variability, which is inconsistent with the results of the present study (Bergin, 2016). Besides, in her study, Madeleine concluded that pain increases variability in limbs, which is inconsistent with the present study's results (Madeleine, et al., 2008). Previous research has shown that restructuring muscle activity or kinematic changes in individuals with pain increases variability in movement strategies, but the overall goal of skill will be maintained (Hodges, Moseley, 2003).

During the learning of the skill, based on the training feature's hypothesis, individuals' performance will be disrupted by changing the training ground. According to this theory, individuals' performance will be disrupted and changed by manipulating the input and output information to the nervous system involved in controlling movement (Bouffard. Bouyer. Roy. & Mercier, 2016). According to studies, pain can cause different spinal cord stimuli and the nervous system involved in controlling movement. The presence of pain also impairs cortical mapping and impairs motor function (Boudreau, Romaniello, Wang, Svensson, Sessle, & Arendt- Nielsen, 2007).

The present study results revealed that the accuracy of people in the presence of pain did not change, and there was no difference between the throwing accuracy in people with pain and without pain. When the pain-free retention test was taken, there was no difference in the accuracy and variability of individuals in the groups. In the phase tests, despite the pain, the individuals were placed in different training conditions; there was no difference in the throwing accuracy between the individuals in the pain and pain-free groups. By examining the effects of pain in different organs, the researcher sought to investigate the effects of local pain and remote pain on the throwing accuracy. The results showed that the pain's location did not affect the throwing accuracy, consistent with Bilodeau's results (Bilodeau, Roosink, & Mercier, 2016). However, Dancey (2016) concluded in his research that local pain causes more attention to movement and improves accuracy, and remote pain causes distraction and reduces the individuals' accuracy, which is inconsistent with the results of the present study (Dancey, et al. 2016).

5. Conclusion

The present study showed that pain does not affect the throwing accuracy and achieving goals, and the coordination pattern variability of a limb did not change. Over time and with pain adaptability, this variability decreased slightly. Based on the present study results, it seems that despite the pain, the nervous system tries to find the least painful pattern of movement and, over time, using a repetitive pattern reduces this pain. A significant study in selecting pain movement strategies includes multiple factors to reduce and prevent further tissue damage. Some of these factors increase and some decrease, including the skill's starting and ending points, the amount of energy and strength a muscle uses effectively, and the sequence and muscles used in the movement.

Ethical Considerations

Compliance with ethical guidelines

All ethical principles are considered in this article. The participants were informed of the purpose of the research and its implementation stages. They were also assured about the confidentiality of their information and were free to leave the study whenever they wished, and if desired, the research results would be available to them. A written consent has been obtained from the subjects. principles of the Helsinki Convention was also observed. In addition, this article has received permission to carry out research activities from the ethics-research committee of Shahid Beheshti University of Tehran (Code: IR.SBU.ICBS.97/1046).

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Authors' contributions

Conceptualization and Methodology: Hasan Arieh, Behrouz Abdoli, and Abbas Haghparast; Investigation and Data collection: Hasan Arieh, Behrouz Abdoli and Alireza Farsi; Data analysis: Hasan Arieh, Behrouz Abdoli and Alireza Farsi; Writing – original draft: Hasan Arieh; Writing – review & editing: Abbas Haghparast, Behrouz Abdoli and Alireza Farsi provided; All authors critically reviewed content and approved final version for publication.

Conflict of interest

The authors declared no conflict of interest.

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