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## Athletic Performance Effect of Acupuncture on Baseball Pitching: A Literature Review

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### Abstract

Acupuncture has been reported to improve performance in various sports. In light of its therapeutic and rehabilitative applications, acupuncture may have a great potential as an ergogenic aid. Acupuncture has been reported to have physiological effects on the human body, including the cardiovascular system, the pulmonary system, and neuro-endocrine responses. This article investigates the possibility of employing acupuncture as an aid to enhance the performance of baseball pitchers. By reviewing textbooks from an AOM college library and published articles from electronic database, the author examined the potential of acupuncture in sports performance, the bio-mechanisms of baseball pitching as well as traditional Chinese medicine (TCM) theories.

When inspecting muscles involved in different pitching stages in terms of qi and blood, and channel theories of TCM the concept of "Sinew Channels" may be comparable with the muscles in modern anatomy. While contributing to the integration of joints, allowing movement of the body, and facilitating the circulation of *qi* and blood, acupuncture has also been credited with yielding higher maximal exercise capacity, facilitating vasodilatation of the peripheral system, and improving the workings of the skeletal muscles.

Acupuncture intervention based on the channel theory is a legitimate and safe ergogenic aid, particularly in the case of studying baseball pitchers. Baseball pitchers and coaches searching for performance improvement may utilize acupuncture as an adjunct to skill training. The prospect of applying acupuncture to the enhancement of baseball pitching performance warrants a pilot study.

**Keywords:** acupuncture, sports enhancement, athletes, baseball pitchers

## Introduction

Due to its analgesia and anti-inflammation properties, acupuncture as part of sports medicine treatment has been reported to be an effective intervention for pain management.<sup>1,2</sup> The assertion that acupuncture can be used to enhance athletic training is supported by positive effects in empirical research results, including improvement of muscle strength and performance enhancement.<sup>1-5</sup>

An observation of a baseball pitcher revealed that the speed of fastballs began to decrease after about 50 pitches. However, with the intervention of acupuncture, the speed remained stable and/or decreased very little after treatments.<sup>6</sup> While contemporary research has focused on the curative properties of acupuncture in common sports injuries, little research has explored the effect of acupuncture on trained baseball pitchers. This article considers the potential of using acupuncture to improve the performance of non-injured pitchers in terms of traditional Chinese medicine (TCM) theories and modern exercise science.

## Methods

Biomedical reference books on the topic of exercise science were selected to investigate baseball pitching mechanisms.<sup>6-10</sup> These books are utilized by colleges and universities at both undergraduate and graduate level kinesiology and exercise science programs as well as baseball pitching coaches. TCM textbooks that are widely utilized by TCM schools were selected for the TCM theory base.

Published literature was electronically searched in the PubMed and Google Scholar databases, with the following keyword combinations: “acupuncture” with “sports performance,” “athletic performance” and “exercise performance.” Publication dates of articles were confined to the past twenty-five years.

Literature recruited for analysis was limited to those published in English. These included original research articles, reviews, commentaries, and clinical observations. Cross references from the reference lists of returned articles with regard to the use of acupuncture in sports and exercise were further examined with manual and electrical acupuncture as the only modalities in research. Papers that focused on clinical issues, such as treatment of pain, pathologies, or sports injuries, were excluded. Articles in which an athlete's performance was influenced by psychological factors or acupuncture and combined with other modalities such as moxa and massage were also excluded.

## Discussion

Four (4) textbooks in the TCM area were selected. Five (5) reference books in exercise science, including biomechanics of sports, baseball pitching mechanisms, sports acupuncture, and sports physiology, were chosen to provide the theory foundation in the field of exercise science. Eight (8) articles returned from the database search and cross reference met the recruiting criteria. These findings that were summarized include the aspects of effects of acupuncture in sports performance and biological mechanisms of baseball pitching.

## Effects of Acupuncture in Sports Performance

Generally, acupuncture is extremely safe if performed by experienced, well-trained practitioners.<sup>11,12</sup> In an article discussing effects of acupuncture on human performance, the authors reported that exercise and acupuncture have some beneficial physiological effects on the human body, including the cardiovascular and pulmonary systems along with neuro-endocrine responses.<sup>2</sup> Another single blind study on generally healthy people found that the effect of acupuncture on the cardiovascular function yielded favorable outcomes in hemodynamic and metabolic mechanisms.<sup>5</sup>

In aerobic sports or sub-maximal exercises, the low intensity and long duration activities involve oxidative metabolism in the energy supply process. The role of acupuncture in the process has been identified to yield higher maximal exercise capacity to perform higher workloads, to affect the central cardiac function and peripheral circulation leading to more efficient cardiac output, and to facilitate vasodilatation of the peripheral system leading to blood flow increases.<sup>2</sup>

Findings suggest that an acupuncture protocol might be beneficial for enhancing muscular strength and power. A study for strength training indicated that a singular acupuncture treatment led to enduring changes in corticomotor excitability and plasticity.<sup>4</sup> Additionally, a study showed that the rate of perceived exertion (RPE) after exercise in the acupuncture group was significantly higher than in the sham and control groups.<sup>3</sup>

## Biological Mechanisms of Baseball Pitching

Developing strength is a part of baseball pitching training. However, pitching a baseball depends upon a series of coordinated neuromuscular patterns, not just the strength of the muscle groups recruited for the activity. Pitching involves using the linear and angular momentum of the body to transfer and translate energy throughout the kinetic chain from feet to fingertips to impart maximum force onto a baseball. The whole body has to be used efficiently to add velocity to the ball and to throw powerfully.<sup>9</sup> Therefore, smooth transition in the baseball pitching stages can maximize ball velocity: the pitching motion can be improved by the lengthened leg turning the body (rotating the pelvis and trunk to the side), by maximally stretched muscles crossing the shoulder

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joint (especially the internal rotator and extensors), and by forcefully contracted body movement to produce the rapid internal rotation and extension of the throwing arm that occurs just prior to release.<sup>10</sup>

Baseball pitching can be divided into different stages, with the windup beginning from the set position. The leg is elevated and flexed to balance a leg stride and leads to cocking, which in turn places the arm in maximal external rotation. Ball acceleration begins with initiation of shoulder internal rotation and ends at the release for deceleration elbow extension. Lastly, follow-through allows for dissipation of energy beginning at the end of shoulder internal rotation and ending with training leg touching the ground.<sup>8</sup>

For effective performance, both the neurological and circulatory systems are involved to react and control the movement patterns of the baseball pitcher. The pitcher must expend a very high level of energy for a short amount of time to increase blood circulation; a major portion of cardiac output is diverted to working the muscles. Therefore, cardiac output can reach an elevated level in muscle tissues.<sup>7</sup>

## Rationale

According to TCM theory, human physiology is based on the transformation of *qi*. *Qi* is the motive force of all physiological processes that provide the essential metabolic basis for bodily maintenance and function.<sup>13,14</sup> It is commonly believed by TCM practitioners that acupuncture can recover the imbalance of body function, reestablish the exhaustive conditions produced by excessive training, and remove obstructive circulation. In other words, acupuncture can favorably influence the energy supply in the body.

The importance of maintaining proper *qi* and blood flow by acupuncture is an established perspective for health maintenance in current TCM literature.<sup>13,14</sup> Research has indicated that increased nitric oxide (NO) synthase activity has been found in regions of the body treated with acupuncture. Because NO is a key regulator of local circulation, and because change in circulation can affect the development and persistence of pain, acupuncture might regulate NO levels.<sup>15</sup> Acupuncture effects circulation, which leads to further speculation about using acupuncture as an ergogenic aid for baseball pitchers.

From a TCM viewpoint, the concept of *channel of sinews* combines the physical entities and functions of muscles and fascia along with their connecting tissue fibers and the tendons.<sup>13</sup> This view of muscles is consistent with Western terminology. According to modern anatomy, muscles connect various joints in the human body. The muscles are also supplied by specific longitudinal distribution vessels and nerves associated with certain regions of the body.<sup>13</sup> The biomedical concept does not include channels but covers physical entities such as peripheral nerves, blood vessels, or lymph vessels. Some researchers indicated that channels and the modern concept of dermatome distribution, or skin areas supplied by spinal nerves, share in part and mutually exhibit certain

characteristics.<sup>16</sup> On the other hand, among the different layers of channels in TCM, muscle channels (*Jin Jing* or *channel of sinews*) are close to the muscles in the modern anatomy by its TCM definition.<sup>13</sup> The muscle channels are characterized by: originating on the extremities, contributing to the integration of joints, and allowing movement of the body, and they are involved with the circulation of *qi* and blood.<sup>17</sup>

In terms of biological mechanisms, pitching a baseball requires smooth energy transfer through the kinetic chain from feet to fingertips.<sup>9</sup> Based on the body movements at different stages of baseball pitching, the author tried to correlate the muscles that are involved in the kinetic chain to the pathways of *Jin Jing*. Kendall has a detailed description of *Jin Jing*.<sup>13</sup> Tables 1 and 2 present channel distributions and pathways of the upper and lower extremities, showing an interpretation of TCM understanding in terms of modern anatomy.

Table 1. Channel Distribution and Pathways of the Upper Extremity<sup>13</sup>

Jin Channel Distribution	Pathways
Medial posterior hand (SI or Taiyang)	Starts on the dorsum of the little finger, ascends to converge at the outer canthus of the eye
Middle posterior hand (SJ or Shaoyang)	Starts at the ulnar side of ring finger, ascends in front of the temple to converge at the corner of the forehead
Lateral posterior hand (LI or Yangming)	Starts at the lateral end of second finger, ascends the entire arm, connects with the mandible, opposite side
Lateral anterior hand (LU or Taiyin)	Starts on the thumb, runs laterally to the shoulder and converges in the lowest ribs
Middle anterior hand (PC or Jueyin)	Starts at the tip of the middle finger, ascends along forearm and shoulder, and descends to scatter over the anterior and posterior aspects of the ribs
Medial anterior hand (HT of Shaoyin)	Starts at the radial aspect of the little finger, ascends along forearm and shoulder, and descends across the diaphragm to terminate at the umbilicus

Table 2. Jin Channels and Pathways of the Lower Extremity<sup>13</sup>

Jin Channel Distribution	Pathways
Posterior lateral foot (UB or Taiyang)	Starts at the little toe, ascends the lateral side of the lower leg to converge at the lateral aspect of the knee. The main ascending branch converges at the occipital bone and then ascends over the crown of the head to the side of the nose.
Lateral foot (GB or Shaoyang)	Starts at the fourth toe and connects with the anterior part of the lateral malleolus, ascends along the lateral aspect of the leg to converge at the lateral aspect of the knee, up to the vertex of the head, descends to the chin and then goes up to the cheekbone
Anterior foot (ST or Yangming)	Starts at the middle three toes, converges on the dorsum of the foot, ascends along the lateral aspect of the tibia and converges at the lateral aspect of the knee, ascends the leg and converges at the hip joint, passes through the lower ribs to reach the spine, ascends the abdomen and chest and reaches the supraclavicular fossa, and ascends to the jaw, mouth, and side of the nose
Anterior foot (SP or Taiyin)	Starts at the big toe, ascends the abdomen, converges at the ribs, and spreads in the chest
Medial foot (LV or Jueyin)	Starts on the dorsum of the big toe, continues along the medial aspect of the thigh
Medial foot (KI or Shaoyin)	Starts beneath the little toe, follow medial surface of the thigh, and ends at the sternum/clavicle junction

At different stages of baseball pitching, the body movements entail coordination among components in the musculoskeletal system. As *Jin Jing* and *Jin Rou* function to integrate joints, allow movements, and circulate *qi* and blood, acupuncture intervention based on the *channel* theory has a legitimate reason to serve these purposes as an ergogenic aid. According to the evidence, there are certain occasions during training when acupuncture may act effectively.<sup>1-5</sup> While the maximum pitching speed is not changed much during the training, and while consistency, endurance, and recovery are improved between pitching bouts, acupuncture may be considered at this stage to enhance/ support skill advancement training and fortify the training for speed increase.

## Conclusion

The pitcher is considered a key athlete on a baseball team—an effective pitcher can single-handedly shut down the offense of an opposing team.<sup>10</sup> Therefore, baseball pitchers and coaches have been searching for effective approaches to improve performance and gain a competitive edge over rivals.<sup>7</sup> Evidence gathered in this article indicates that using acupuncture may be a safe and effective way to increase and maintain performance of baseball pitchers. The prospect applying acupuncture to the enhancement of baseball pitching performance warrants a pilot study or observational study.

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