



Contents lists available at ScienceDirect

Physical Therapy in Sport

journal homepage: www.elsevier.com/ptsp

Case study

Treatment of chronic Achilles tendon pain by Kinesio taping in an amateur badminton player

Jung-hoon Lee^{a,b}, Won-gyu Yoo^{c,*}^a Department of Physical Therapy, Inje University Pusan Paik Hospital, Republic of Korea^b Department of Physical Therapy, The Graduate School, Inje University, Republic of Korea^c Department of Physical Therapy, College of Biomedical Science and Engineering, Inje University, 607 Obang-dong, Gimhae, Gyeongsangnam-do 621-749, Republic of Korea

ARTICLE INFO

Article history:

Received 31 January 2011

Received in revised form

11 July 2011

Accepted 13 July 2011

Keywords:

Achilles tendon taping

Badminton

Chronic Achilles tendon pain

ABSTRACT

Objective: To evaluate the effects of Kinesio taping on a patient with chronic Achilles tendon pain.**Design:** Case report.**Case description:** A 22-year-old male amateur badminton player slipped on the ground as he landed after jumping while playing badminton, resulting in chronic Achilles tendon pain of the dominant (right) leg. We performed Achilles tendon taping (ATT) over 5 weeks.**Results:** The patient's ultrasonography showed that the tendon thickness was moderately reduced from 0.42 cm to 0.37 cm and that the angles of active dorsiflexion and active plantar flexion without pain increased from 15° to 20° and from 20° to 45°, respectively. The Victorian Institute of Sport Assessment-Achilles (VISA-A) questionnaire score increased from 64 to 95, and the load-induced pain assessment score decreased from 6 to 0. The pain threshold increased from 0.8 kg to 10 kg. The tenderness at 3 kg, assessed on a numeric rating scale, decreased from 7 to 0, and the patient was able to play badminton and soccer without pain.**Conclusions:** We verified the effect with an increase in the active ankle joint range of motion and the VISA-A questionnaire score, which was achieved by a decrease in tenderness and pain from repeated ATT application.

© 2011 Elsevier Ltd. All rights reserved.

1. Introduction

Achilles tendon injuries occur frequently among athletes participating in running, orienteering, badminton, tennis, soccer, and volleyball (Fahlström, Lorentzon, & Alfredson, 2002), as well as in the general population (Maffulli & Kader, 2002). Badminton in particular is a sport that involves repeated, rapid forward lunges; the dominant leg bears a greater load, and tendons are heavily strained (Boesen, Boesen, Koenig, Bliddal, Torp-Pedersen, & Langberg, 2011).

The nomenclature for disorders of the Achilles tendon is important, as the treatment is dependent on the underlying tendon pathology (Macintyre & Joy, 2000). When acute tendonitis occurs, the inflammation is most often characterized by swelling, local pain, and occasionally crepitus (Macintyre & Joy, 2000). At this stage, symptomatic treatments such as rest, non-steroidal anti-

inflammatory drugs, heel lifts, and local physical therapy are used to control the inflammation and heal the injured tendon (Macintyre & Joy, 2000). Achilles tendon conditions such as tendinosis are chronic, but generally not inflammatory, although the area can be painful to touch, and this condition is characterized by tendon degeneration (Maffulli, Khan, & Puddu, 1998). Based on the etiology, Achilles tendinosis can be caused by a combination of failure of the normal healing mechanisms and repeated trauma (Costa, Donell, & Tucker, 2006; Schepsis, Jones, & Haas, 2002). At this stage, pathological processes including localized painful thickening of the tendon increase (Ohberg, Lorentzon, & Alfredson, 2004). Ultrasonography has been used to quantify Achilles tendon degeneration (Fredberg & Bolvig, 2002; Grechenig, Clement, Bratschitsch, Fankhauser, & Peicha, 2002; Macintyre & Joy, 2000). Painful phases of chronic Achilles tendon disorders prolong the healing time (Alfredson & Lorentzon, 2000; Macintyre & Joy, 2000).

The use of Kinesio Taping (KT) for the treatment of joint sprains and instability, soft tissue inflammation, and muscle pain and weakness (Jaraczewska & Long, 2006) is gradually increasing in sport medicine and orthopedics (Yasukawa, Patel, & Sisung, 2006).

* Corresponding author. Tel.: +82 55 320 3994; fax: +82 55 329 1678.

E-mail address: won7y@inje.ac.kr (W.-g. Yoo).

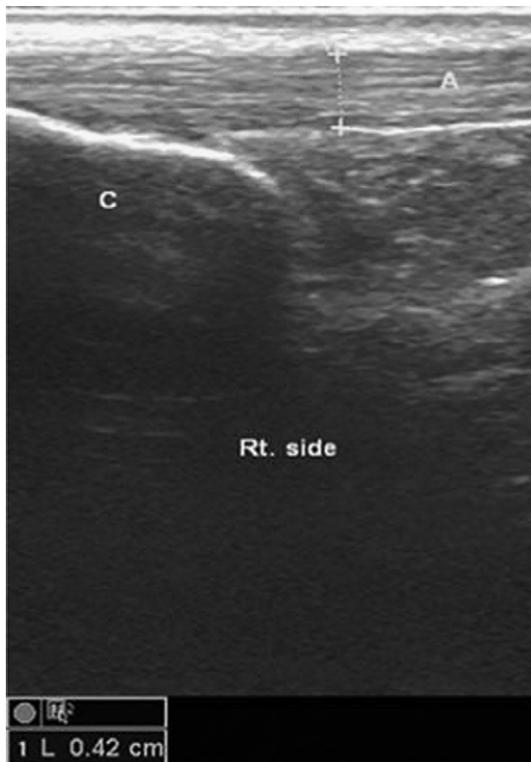


Fig. 1. Thickness of the right Achilles tendon pre-insertional area (0.42 cm) on ultrasonography of the patient at the initial assessment; A, Achilles tendon; C, Calcaneus; Rt, Right; L, Level.

However, the effect of KT on various sports injuries has not been sufficiently studied. This case report is the first to describe the results of KT on a patient with chronic Achilles tendon pain.

2. Case description

A 22-year-old male amateur badminton player slipped on the ground as he landed after jumping while playing badminton 6

months previously, resulting in pain in the Achilles tendon of the dominant (right) leg. The pain was slightly relieved after receiving therapeutic ultrasound, undergoing transcutaneous electrical nerve stimulation (TENS), and stopping sports activity that might provoke pain. However, he was not able to undergo continuous treatment. Within a month, he developed severe pain during active plantar flexion and palpation of the pre-insertional area of the Achilles tendon after returning to play badminton. The patient was not able to sit on his knees (e.g., ankle plantar flexion position), play badminton, or play soccer because he was not able to run or kick the ball.

2.1. Initial assessment

The initial ultrasonography showed that the pre-insertional area of the right Achilles tendon, where the pain was found, was mildly thicker (0.42 cm) (Fig. 1) than that of the left Achilles tendon (0.38 cm). Active dorsiflexion (ADF) and active plantar flexion (APF), measured with a goniometer, were 15° (population normal angle, 20°) (Palmer & Epler, 1998) and 20° (population normal angle, 45°) (Palmer & Epler, 1998), respectively, due to pain. The VISA-A questionnaire is a reliable and valid instrument for the evaluation of pain intensity and levels of function in patients with Achilles tendon disorders (Dogramaci, Kalaci, Küçükbaş, Inandi, Esen, & Yanat, 2011; Lohrer & Nauck, 2009; Robinson et al., 2001; Silbernagel, Thomeé, & Karlsson, 2005). Scores on this eight-item questionnaire range from 0 to 100. A score of 100 indicates no pain and complete function (Rompe, Furia, & Maffulli, 2008). The VISA-A questionnaire score was 64 (population normal range >95), and the load-induced pain, assessed on a numeric rating scale (Rompe et al., 2008) from 0 to 10 (e.g., 0 representing no pain and 10 representing the worst imaginable pain), was 6. The pressure-pain threshold was assessed with an algometer (Pain Test-Model FPK; Wagner Instruments, Greenwich, CT). The algometer was pressed against the tenderest area of the right Achilles tendon, and the pressure was increased by 0.1 kg/s until the patient experienced pain; the PPT was 0.8 kg. Rompe et al. (2008) defined tenderness using a numeric rating scale following the application of 3 kg of pressure to the tenderest area of the Achilles tendon. The tenderness determined using an algometer at 3 kg was 7 on a numeric rating scale of 0–10.

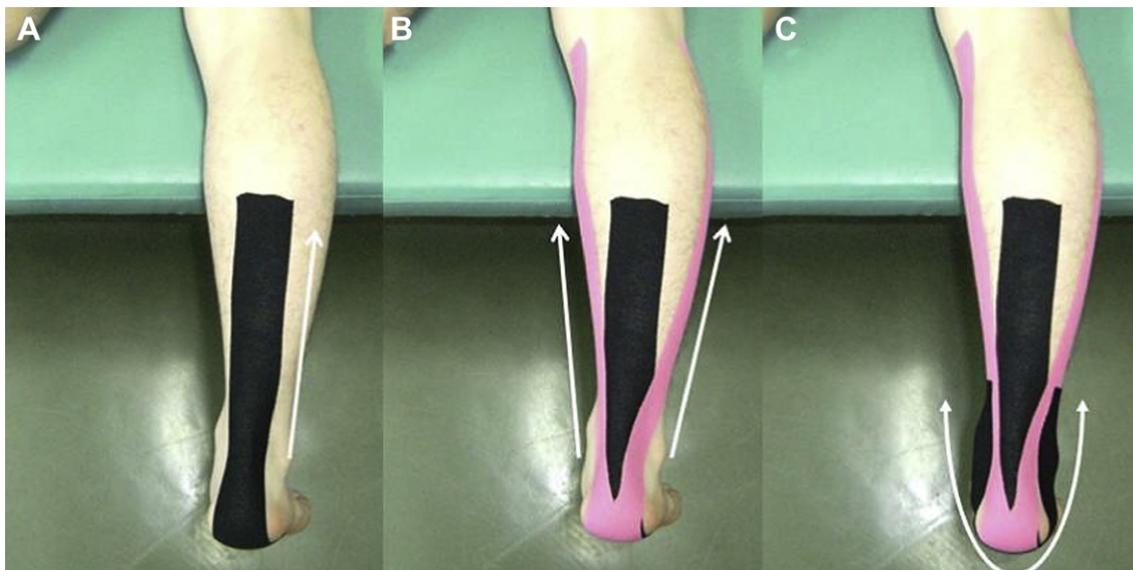


Fig. 2. Application of the Kinesio tape (A) Achilles tendon, (B) Soleus and gastrocnemius muscles complex, (C) elevating the calcaneus in the ankle mortise.

2.2. Intervention: Achilles tendon taping

We performed Achilles tendon taping (ATT) with Kinesio tape over 5 weeks (six times per week for an average of 10 h each time); no other therapy or exercise was performed to treat Achilles tendon pain except ATT. ATT was applied by a KT expert by stretching the Kinesio tape (Kinesio Tex, KT-X-050, Tokyo, Japan) by approximately 130–140% (Kase, 2003). For the KT application, the Achilles tendon was stretched in the prone position by dorsiflexion within the pain-free range (15–20°), and an I-type strip was applied from the posterior surface of the calcaneus distal to the upper part of the gastrocnemius junction (Kase, Wallis, & Kase, 2003) (Fig. 2A). For KT of the soleus and gastrocnemius muscle complex, a Y-shaped strip was applied from the posterior surface of the calcaneus distal to the articular surfaces of the lateral and medial condyles of the femur in the same position (Kase et al., 2003) (Fig. 2B). The I-type strip was applied to the ankle joint in a neutral position in both directions to elevate the calcaneus in the ankle mortise over the origin of the plantar fascia (Kase et al., 2003) (Fig. 2C). In addition, Kinesio tape was immediately removed if the skin became itchy to avoid discontinuation of the treatment by an adverse reaction to the tape.

3. Results

As shown in Table 1, after one week of ATT intervention, the ADF and APF angles were increased to 20° and 40°, respectively. The VISA-A questionnaire was increased to a score of 72. The load-induced pain assessment was decreased to a score of 2; the pain threshold increased to 3.5 kg; and tenderness at 3 kg, assessed on a numeric rating scale, was decreased to 3. After two weeks of ATT intervention, the VISA-A questionnaire was increased to a score of 86. The load-induced pain assessment was decreased to a score of 0; the pain threshold increased to 8 kg; and tenderness at 3 kg, assessed on a numeric rating scale, was decreased to 2. After three weeks of ATT intervention, the APF angle was increased to 45°. The pain threshold increased to 9 kg; and tenderness at 3 kg, assessed on a numeric rating scale, was decreased to 0. After four weeks of ATT intervention, the pain threshold increased to 10 kg. In the final assessment, ultrasonography showed that the tendon thickness had been moderately reduced from 0.42 cm to 0.37 cm (Fig. 3), and the ADF and APF angles were 20° and 45°, respectively, without pain, and the patient was able to sit on his knees. The VISA-A questionnaire score was 95, the load-induced pain assessment score was 0. No pain was felt even at 10 kg or greater in the pain-threshold test. The tenderness at 3 kg, assessed on a numeric rating scale, was 0, and the patient was able to play badminton and soccer without any pain.

4. Discussion

While running and jumping, the Achilles tendon is subjected to loads as high as 6–12 times the body weight. Such high repetitive

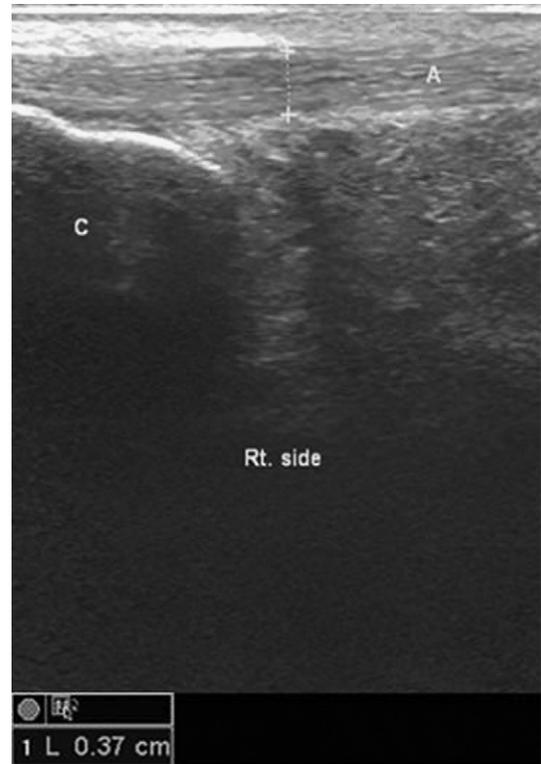


Fig. 3. Thickness of the right Achilles tendon pre-insertional area (0.37 cm) on ultrasonography of the patient at the final assessment; A, Achilles tendon; C, Calcaneus; Rt, Right; L, Level.

loading is considered to be one of the main pathological stimuli to the Achilles tendon (Paavola, Kannus, Järvinen, Khan, Józsa, & Järvinen, 2002). Badminton is a sport that requires jumps, lunges, quick hand motions, and changes in direction in a wide variety of postural positions (Shariff, George, & Ramlan, 2009). When landing after a jump while playing badminton, the body is upright while the ankle is maintained in a plantar-flexed position due to the activity of the gastrocnemius and soleus muscles (Schepesis et al., 2002). In the present case, the original injury was caused by the ankle being forced upwards while in a plantar-flexed position when landing after a jump during badminton, leading to a compression injury of the Achilles tendon. Furthermore, continuous treatment was not provided in the acute phase, and the patient continued to play badminton prior to complete recovery. Thus, the severe pain may have occurred gradually as repetitive microtrauma was imposed on the Achilles tendon. Based on the etiology, the Achilles tendinosis was caused by a combination of failure of the normal healing mechanisms and repeated trauma (Costa et al., 2006; Schepesis et al., 2002). In the more chronic phase of Achilles tendon disorders, the cardinal symptom is exercise-induced pain. In this case, a limited range of motion of approximately 5° in ADF and 25° in APF were

Table 1
The patient physical assessment results.

Assessment	Initial	1 week	2 week	3 week	4 week	Final
Active dorsiflexion (ADF) angles (°)	15	20	20	20	20	20
Active plantar flexion (APF) angles (°)	20	40	40	45	45	45
VISA-A questionnaire score ranged from 1 to 100	64	72	86	86	86	95
The load-induced pain assessed on a numeric rating scale from 0 to 10	6	2	0	0	0	0
The pain-threshold (kg)	0.8	3.5	8	9	10	10
The tenderness at 3 kg assessed on a numeric rating scale from 0 to 10	7	3	2	0	0	0

found because of the pain. The peritendinous tissue appears thickened (Järvinen, Józsa, Kannus, Järvinen, Kvist, & Leadbetter, 1997) while crepitation and swelling diminish (Józsa & Kannus, 1997) inflammation is absent (Paavola et al., 2002). At this stage, the patient is generally unable to perform sports (Schepesis et al., 2002).

The mechanism of the effect of KT is not known, but the proposed hypotheses from previous studies show that the rationale for KT applied to the Achilles tendon and gastrocnemius and soleus muscles is to protect and support the joint during functional ankle movement (Lin, Hung, & Yang, 2011). In addition, the elasticity of Kinesio tape may improve blood and lymph circulation and decrease pain (Kase et al., 2003). Different from conventional tapes, Kinesio tape has an elasticity of 130–140% (Kase, 2003), which allows ankle movement in both dorsiflexion and plantar flexion with ATT (Kaya, Zinnuroglu, & Tugcu, 2011). In this case, the skin of the affected area was stretched before the application of KT through ankle dorsiflexion. After Kinesio tape is stretched by 130–140%, the taped skin forms convolutions when the skin and muscles return to their neutral positions (Kase, 2003). The flow of lymphatic fluid is limited when the space beneath the skin is compressed (Kase, 2003). Such compression provides pressure to the pain receptors beneath the skin and gives a “discomfort signal,” which is pain (Kase, 2003). The stretched Kinesio tape application may increase the space beneath the skin as the skin is lifted by convolution, and the flow of blood and lymphatic fluid may be improved (Kase, 2003). In a previous study, elastic adhesive tape application during passive exercise resulted in a significant increase in the lymph flow rate compared with the absence of exercise with tape (Shim, Lee, & Lee, 2003).

The tension of Kinesio tape created by increased stimulation during active ankle movement may have also created tension in the soft tissue structures (González-Iglesias, Fernández-de-Las-Peñas, Cleland, Huijbregts, & Del Rosario Gutiérrez-Vega, 2009). Increased tension may facilitate a pain inhibitory mechanism (e.g., gate control theory) by providing an afferent stimulus to large-diameter nerve fibers to mitigate nociception (Thelen, Dauber, & Stoneman, 2008). As the patient’s pain level was reduced, the fear of pain during ankle movement might have been reduced by proper sensory feedback, thus improving ankle range of motion (González-Iglesias et al., 2009).

Stimulation of cutaneous mechanoreceptors by KT activates nerve impulses, leading to local depolarization, which triggers nerve impulses to travel along afferent fibers to the central nervous system (Kase et al., 2003). In recent studies, KT increased the EMG activity of the scapular muscles (Lin et al., 2011), lower trapezius muscle (Hsu, Chen, Lin, Wang, & Shih, 2009), and vastus medialis muscle (Slupik, Dwornik, Bialoszewski, & Zych, 2007). Additionally, KT application on the anterior surface of the thigh leads to increases in the isokinetic eccentric peak torque of the vastus medialis, vastus lateralis, and rectus femoris (Vithoulka, Beneka, Malliou, Aggelousis, Karatsolis, & Diamantopoulos, 2010). Thus, KT application may improve the muscle activity of the calf muscles, reducing Achilles tendon loading.

Also, the third I-type strip application technique to elevate the calcaneus in the ankle mortise might have acted as the mechanical correction that improved the range of motion during active plantar flexion (Kase et al., 2003).

5. Conclusion

We applied ATT with Kinesio tape to our patient, who was not able to perform sports activities because of the limited range of motion in the ankle joint due to tenderness and pain in the Achilles tendon. We verified the effect with an increase in the active ankle joint range of motion and the VISA-A questionnaire score, which was achieved by a decrease in tenderness and pain from repeated

ATT application. Further research should be performed to strengthen the validity and credibility of the effects of ATT with a number of athletes and patients with Achilles tendon disorders.

Conflict of interest

The authors declare no conflict of interest.

Ethical approval

None.

Funding

None declared.

Acknowledgements

This research was supported by Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Education, Science and Technology (No. 2011-0005580).

References

- Alfredson, H., & Lorentzon, R. (2000). Chronic Achilles tendinosis. *Critical Reviews in Physical and Rehabilitation Medicine*, 12, 103–117.
- Boesen, A. P., Boesen, M. I., Koenig, M. J., Bliddal, H., Torp-Pedersen, S., & Langberg, H. (2011). Evidence of accumulated stress in Achilles and anterior knee tendons in elite badminton players. *Knee Surgery, Sports Traumatology, Arthroscopy*, 19, 30–37.
- Costa, M. L., Donell, S. T., & Tucker, K. (2006). The long-term outcome of tendon lengthening for chronic Achilles tendon pain. *Foot & ankle international*, 27, 672–676.
- Dogramaci, Y., Kalaci, A., Küçükbaş, N., Inandi, T., Esen, E., & Yanat, A. N. (2011). Validation of the VISA-A questionnaire for Turkish language: the VISA-A-Tr study. *British Journal of Sports Medicine*, 45, 453–455.
- Fahlström, M., Lorentzon, R., & Alfredson, H. (2002). Painful conditions in the Achilles tendon region: a common problem in middle-aged competitive badminton players. *Knee Surgery, Sports Traumatology*, 10, 57–60.
- Fredberg, U., & Bolvig, L. (2002). Significance of ultrasonographically detected asymptomatic tendinosis in the patellar and achilles tendons of elite soccer players: a longitudinal study. *American Journal of Sports Medicine*, 30, 488–491.
- González-Iglesias, J., Fernández-de-Las-Peñas, C., Cleland, J. A., Huijbregts, P., & Del Rosario Gutiérrez-Vega, M. (2009). Short-term effects of cervical kinesio taping on pain and cervical range of motion in patients with acute whiplash injury: a randomized clinical trial. *Journal of Orthopaedic and Sports Physical Therapy*, 39, 515–521.
- Grechenig, W., Clement, H., Bratschitsch, G., Fankhauser, F., & Peicha, G. (2002). Ultrasound diagnosis of the Achilles tendon. *Orthopade*, 31, 319–325.
- Hsu, Y. H., Chen, W. Y., Lin, H. C., Wang, W. T., & Shih, Y. F. (2009). The effects of taping on scapular kinematics and muscle performance in baseball players with shoulder impingement syndrome. *Journal of Electromyography and Kinesiology*, 19, 1092–1099.
- Jaraczewska, E., & Long, C. (2006). Kinesio® taping in stroke: improving functional use of the upper extremity in hemiplegia. *Topics in Stroke Rehabilitation*, 13, 31–42.
- Järvinen, M., Józsa, L., Kannus, P., Järvinen, T. L., Kvist, M., & Leadbetter, W. (1997). Histopathological findings in chronic tendon disorders. *Scandinavian Journal of Medicine & Science in Sports*, 7, 86–95.
- Jozsa, L. G., & Kannus, P. (1997). *Human tendons: anatomy, physiology, and pathology*. Champaign, IL: Human Kinetics.
- Kase, K. (2003). *Illustrated Kinesio-Taping* (4th ed.). Tokyo: Ken'i-kai Information.
- Kase, K., Wallis, J., & Kase, T. (2003). *Clinical therapeutic applications of the Kinesio® Taping method*. Albuquerque, NM: Kinesio® Taping Association.
- Kaya, E., Zinnuroglu, M., & Tugcu, I. (2011). Kinesio taping compared to physical therapy modalities for the treatment of shoulder impingement syndrome. *Clinical Rheumatology*, 30, 201–207.
- Lin, J. J., Hung, C. J., & Yang, P. L. (2011). The effects of scapular taping on electromyographic muscle activity and proprioception feedback in healthy shoulders. *Journal of Orthopaedic Research*, 29, 53–57.
- Lohrer, H., & Nauck, T. (2009). Cross-cultural adaptation and validation of the VISA-A questionnaire for German-speaking achilles tendinopathy patients. *BMC Musculoskeletal Disorders*, 10, 134.
- Macintyre, J., & Joy, E. (2000). Foot and ankle injuries in dance. *Clinics in Sports Medicine*, 19, 351–368.
- Maffulli, N., & Kader, D. (2002). Tendinopathy of tendo achillis. *Journal of Bone and Joint Surgery-British*, 84, 1–8.
- Maffulli, N., Khan, K. M., & Puddu, G. (1998). Overuse tendon conditions: time to change a confusing terminology. *Arthroscopy*, 14, 840–843.
- Ohberg, L., Lorentzon, R., & Alfredson, H. (2004). Eccentric training in patients with chronic Achilles tendinosis: normalised tendon structure and decreased thickness at follow up. *British journal of sports medicine*, 38, 8–11.

- Paavola, M., Kannus, P., Järvinen, T. A., Khan, K., Józsa, L., & Järvinen, M. (2002). Achilles tendinopathy. *Journal of Bone Joint Surgery (American)*, *84*, 2062–2076.
- Palmer, L. M., & Epler, M. E. (1998). *Fundamentals of musculoskeletal assessment techniques* (2nd ed.). Philadelphia: Lippincott Williams & Wilkins.
- Robinson, J. M., Cook, J. L., Purdam, C., Visentini, P. J., Ross, J., Maffulli, N., et al. (2001). The VISA-A questionnaire: a valid and reliable index of the clinical severity of Achilles tendinopathy. *British journal of sports medicine*, *35*, 335–341.
- Rompe, J. D., Furla, J., & Maffulli, N. J. (2008). Eccentric loading compared with shock wave treatment for chronic insertional achilles tendinopathy. A randomized, controlled trial. *Journal of Bone Joint Surgery (American)*, *90*, 52–61.
- Schepers, A. A., Jones, H., & Haas, A. L. (2002). Achilles tendon disorders in athletes. *American Journal of Sports Medicine*, *30*, 287–305.
- Shariff, A. H., George, J., & Ramlan, A. A. (2009). Musculoskeletal injuries among Malaysian badminton players. *Singapore Medical Journal*, *50*, 1095–1097.
- Shim, J. Y., Lee, H. R., & Lee, D. C. (2003). The use of elastic adhesive tape to promote lymphatic flow in the rabbit hind leg. *Yonsei Medical Journal*, *44*, 1045–1052.
- Silbernagel, K. G., Thomeé, R., & Karlsson, J. (2005). Cross-cultural adaptation of the VISA-A questionnaire, an index of clinical severity for patients with Achillsdes tendinopathy, with reliability, validity and structure evaluations. *BMC Musculoskeletal Disorders*, *6*, 12.
- Slupik, A., Dwornik, M., Bialoszewski, D., & Zych, E. (2007). Effect of Kinesio taping on bioelectrical activity of vastus medialis muscle: preliminary report. *Ortopedia, Traumatologia, Rehabilitacja*, *9*, 644–651.
- Thelen, M. D., Dauber, J. A., & Stoneman, P. D. (2008). The clinical efficacy of kinesio tape for shoulder pain: a randomized, double-blinded, clinical trial. *Journal of Orthopaedic and Sports Physical Therapy*, *38*, 389–395.
- Vithoulka, I., Beneka, A., Malliou, P., Aggelousis, N., Karatsolis, K., & Diamantopoulos, K. (2010). The effects of Kinesio-Taping® on quadriceps strength during isokinetic exercise in healthy non athlete women. *Isokinetics and Exercise Science*, *18*, 1–6.
- Yasukawa, A., Patel, P., & Sisung, C. (2006). Pilot study: investigating the effects of Kinesio Taping in an acute pediatric rehabilitation setting. *American Journal of Occupational Therapy*, *60*, 104–110.