

## **Management of Acute Ankle Sprain: A Literature Review**

**Ketut Kris Adi Marta<sup>1</sup>, I Ketut Siki Kawiya<sup>2</sup>**

<sup>1</sup>Faculty of Medicine, Udayana University, Bali-Indonesia

<sup>2</sup>Head of Orthopedics and Traumatology Study Program of Faculty of Medicine of Udayana University, Sanglah Public Hospital of Denpasar, Bali-Indonesia

---

### **ABSTRACT**

Among musculoskeletal injuries, the incidence of ankle sprains is between 15% and 20% of sports injuries. The ankle is supported laterally by the anterior talofibular ligament, calcaneofibular ligament and posterior talofibular ligament, whilst the medial aspect is supported by the deltoid ligament. Ankle sprains can be either acute sprains, which can be further classified into three grades depending on the severity of the injury, or chronic instability. Acute ankle sprain is usually managed conservatively and functional rehabilitation failure by conservative treatment leads to development of chronic ankle instability, which most often requires surgical intervention. Successful treatment of acute ankle sprain can be achieved with individualized, aggressive and non-operative measures. Surgery should always be indicated on an individual basis.

**Keywords:** acute ankle sprain, management.

---

### **Corresponding author:**

**Ketut Kris Adi Marta**

**Address: Faculty of Medicine, Udayana University,  
Bali-Indonesia**

**Email: krisadi30@yahoo.co.id**

### **INTRODUCTION**

A history of a twisting injury followed by pain and swelling could suggest anything from a minor sprain to a fracture. If the patient is able to walk, and bruising is only faint and slow to appear, it is probably a sprain; if bruising is marked and the patient unable to put any weight on the foot, this suggests a more severe injury.<sup>1,2,3,4</sup> Ankle sprain is an injury that occurs in the ankle as a result of trauma to the soft tissue structures of the ankle resulting in painful wrenching of soft tissue. The common 'twisted ankle' is due to unbalanced loading with the ankle inverted and plantarflexed. First the anterior talofibular and then the calcaneofibular ligament is strained; sometimes the talocalcaneal ligaments also are injured.<sup>5-10</sup>

Among all ankle injuries, ankle sprains are the most common and account for approximately 80%, of which 77% are lateral sprains. 73% of lateral ankle sprains are due to rupture or tear of the ATFL. Ankle sprain incidence rates range from to 5.3-7.0 sprained ankles per 1000 person-years in Europe.<sup>11</sup> The ankle sprain incidence rate in the United States is 2.15 per 1000 person-years with no significant differences in gender. Furthermore, acute ankle sprains account for between 3% and 10% of all emergency department attendances in the United Kingdom.<sup>12</sup> According to secondary data obtained Polyclinic KONI Jakarta in September-October 2012

with secondary data, the population in this study are all athletes of PON XVIII / 2012 DKI Jakarta. Results obtained are 85 injuries in 2009, 146 injuries in 2010, 353 injuries in 2011, and 419 injuries in 2012. Prevalence of injuries continues to rise, the most injuries that found in the observation is ankle sprains (ligament injury) as much as 41.1%, the most injured body part is the lower limb as much as 60%. Acute injuries are 64.4% of cases and 35.6% is chronic injury of all cases.<sup>13</sup>

Acute ankle sprain is usually managed conservatively and functional rehabilitation failure by conservative treatment leads to development of chronic ankle instability, which most often requires surgical intervention.<sup>14-15</sup> Successful treatment of acute ankle sprain can be achieved with individualized, aggressive and non-operative measures. Surgery should always be indicated on an individual basis. Therefore, the author considers that it is necessary to discuss about appropriate management of acute ankle sprain to prevent chronic ankle instability thus no need for a surgical treatment.

### **FUNCTIONAL ANATOMY**

Ligaments are elastic structure and a passive stabilization of the ankle and foot joints. Part of ligaments that frequently injured are ligament complex lateral legs include: anterior talofibular ligament which serves to resist movement in the direction of plantar flexion, posterior talofibular ligaments which serves to resist movement toward inverse, ligaments calcaneocuboideum ligaments which serves to resist the push for plantar flexion, the talocalcaneus ligaments which serves to resist

movement toward inversion and calcaneofibular ligaments that serves to resist movement toward inversion makes leg joints locked to a certain extent so that there is stability in the legs and cervical ligament. There is also plantar cuneonavicular ligament, plantar cuboideonavicular ligament, plantar intercuneiform ligament, plantar cuneocuboid ligaments and also interrosea ligaments such as interrosea intercuneiform ligaments and interrosea cuneocuboideum ligaments. In between the tarsal and metatarsal ligaments are dorsal tarsometatarso ligaments, plantar tarsometatarso ligaments and interrosea cuneometatarsal ligaments. Among osseum metatarsal there are dorsal interrosea metatarsal ligaments that located at the base of the metatarsal.<sup>8,9-12,16-20</sup>

### ETIOLOGY AND CLASSIFICATION

Ankle sprain caused by inversion injury that can cause injury to the lateral ligament complex, sometimes followed by tendon injury.<sup>21</sup> The things that facilitate the occurrence of sprains ankle chronic are intrinsic and extrinsic factors.<sup>22</sup> Extrinsic factors including the training errors, poor performance, the wrong technique and tread on uneven surfaces, intrinsic factors including damage of soft tissue, the instability of the active foot and ankle muscles (muscle weakness), poor proprioceptive, hypermobile foot and ankle.<sup>23</sup> The risk factors of chronic ankle sprain injury can be caused abnormal foot posture, such as: dynamic pes planus, pes cavus and flat foot. Classification helps in identifying the damage level and correct treatment.<sup>24,25</sup> Table 1 shows the three grades of acute ankle sprain. Practically, acute ankle sprain can be classified as stable or unstable according to the findings on physical examination.

The Ottawa Ankle Rules (OAR) were developed to reduce the unnecessary radiographs and decide when radiographic studies are indicated in patients who undergo ankle trauma. X-ray examination is called for if there is: (1) pain around the malleolus; (2) inability to take weight on the ankle immediately after the injury; (3) inability to take four steps in the Emergency Department; (4) bone tenderness at the posterior edge or tip of the medial or lateral malleolus or the base of the fifth metatarsal bone. The OAR were first tested on adult patients with ankle sprains from acute injuries, revealing almost perfect results for adult and young populations. A previous study revealed that the OAR were significantly sensitive in excluding ankle fractures. As such, the OAR reduced unnecessary radiographs by 30-40%. For patients who have had persistent pain, swelling, instability and impaired function over 6 weeks or longer, despite appropriate early treatment, magnetic resonance imaging (MRI) or computed tomography (CT) will be required to assess the extent of soft tissue injury or subtle bony changes.<sup>8,10-12,26-30</sup>

### MANAGEMENT

#### Conservative Treatment

Conservative treatment is very important in the early weeks after the injury. In the conservative treatment known as RICE (Rest, Ice, Compression and Elevation). However, some articles add "protection" and "rehabilitation" in the initial treatment and make the acronym became PRICE (Protection, Rest, Ice, Compression, Elevation and Rehabilitation).<sup>11,12</sup> Term "protection" means to immobilize ankle to reduce any future damage by using some tools. Grade 1 of ankle sprain doesn't need serious immobilisation, it can be treated well by flexible or elastic wrap. Grade II ankle injuries are

**Table 1. Classification of acute ankle sprain according to its grade, severity, pathophysiology and clinical findings.<sup>8</sup>**

Grade	Severity	Pathophysiology	Clinical findings
Grade 1	Mild	Stretch of the Anterior Talofibular ligament (ATFL), causing tear of the ligament fibers	Mild swelling, no laxity, little ecchymosis, and difficulty in full weight bearing.
Grade 2	Moderate	Moderate injury to the lateral ligamentous complex with a complete tear of the ATFL ± Partial tear of the Calcaneofibular ligaments (CFL).	Localized swelling, hemorrhage ecchymosis, and anterolateral tenderness. Abnormal laxity may be mild or absent.
Grade 3	Severe	Complete disruption of the ATFL along with CFL and Posterior Talofibular ligaments (PTFL).	Tenderness, swelling and ecchymosis on the lateral ankle and heel side with marked laxity.

### Imaging

likely to require support by using a flexible wrap and a splint for the first few days until they are pain-free. The use of ankle braces has been shown to be superior to an elastic support or compression bandages. Patients treated with an elastic support bandage took longer to return to work and reported increased subjective instability. In Grade III, controlling the range of the patient's motion is recommended. The four main procedural methods of treatment of the ankle: Rest, Ice, Compression and Elevation, which can be performed in the first 2-3 days.<sup>8,31-33</sup> Patients are provided with crutches to help them walk until they can walk normally. They must take a rest to give time for injury to heal themselves. Weight-bearing is limited to light weight-bearing. As part of cryotherapy, ice immersion is recommended for up to 20 minutes every 2-3 hours. To apply compression, the patient is provided with a flexible bandage to reduce swelling, but some articles recommend add splint instead the flexible bandage alone to reduce the swelling. To facilitate a reduction in swelling and for better venous and lymphatic drainage, the injured ankle should be elevated at a level higher than the heart.<sup>8</sup>

After an ankle injury, functional rehabilitation provides a very significant positive effect, and in addition to helping patients to get their normal daily activity back and prevent the possibility of chronic instability of the ankle. Semi-rigid ankle braces used to support the position of the feet perfectly. Movement exercises such as leg circles, mild tendon stretching, exercise alphabet, dorsiflexion, eversion, inversion, taking marbles with toes, and toe curling and walking are encouraged to assist lymphatic drainage. It is also recommended to wrap the ankle with elastic bandage to control the edema.<sup>8,9,34-36</sup> Patients can use crutches to help patients when walking when sprain ankle still painful. Weight-bearing is possible when it's tolerated. Ankle-foot orthoses can be used along with ankle braces filled with water or gel to facilitate the rehabilitation, which can be used to limit plantarflexion-dorsiflexion. Patients typically require a proprioceptive training program where proprioceptive patients are often affected. Work activities and sports that require strenuous physical movement should be reduced when the initial period of post-injury to prevent pain and further complications. Ankle injury to Grade I and II, the patient should immediately perform functional rehabilitation when the swelling and pain is reduced. Patient can begin to practice simple movements when patients feel the ankle has been pain-free. To prevent recurrence, rehabilitation programs should be conducted at least between 3 and 6 weeks. During the functional rehabilitation

program, braces, elastic bandages, taping or splints are recommended in order to decrease ankle instability and control swelling.<sup>7,8,9</sup>

### **Pharmacological treatment**

#### **Non-Steroidal Anti Inflammatory Drugs (NSAIDs)**

Non-steroidal anti-inflammatory drugs (NSAIDs) in acute phase of ankle sprain may useful. A clinical trial demonstrated that NSAIDs could reduce symptom and inflammation effect and enhance the recovery in sports-related injuries. The NSAIDs reduce pain and inflammation by inhibit cyclo-oxygenase (COX). COX-1 isoform found in many tissues and it's essential for homeostatic functions, such as gastric mucosal protection and normal platelet aggregation. COX-2 isoform is mostly expressed locally on tissue inflammation. Non-selective NSAIDs such as diclofenac, piroxicam and naproxen become a common adjuvant therapy for acute ankle sprain. They reduce the inflammatory reaction by inhibit both COX-1 and COX-2 while selective COX-2 inhibitors only inhibit COX-2.<sup>10,37-38</sup> Therefore, non-selective NSAIDs have side effects that interfere with disorders of the gastrointestinal tract caused by non-selective NSAIDs inhibit COX-1 isoform, which play a role in gastric mucosal protection. Clinical trials had proof that celecoxib (400 mg loading dose followed by 200 mg twice daily for 7 days) and valdecoxib (40 mg twice daily on day 1 followed by 40 mg once daily on days 2 – 7) was as efficacious as non-selective NSAIDs in treating acute pain due to ankle sprain from as early as 24 h after the start of treatment.<sup>11</sup> Using standard efficacy measures, patients in both treatment groups demonstrated a clinically significant reduction in pain from baseline and a rapid return to normal function. With its platelet-sparing properties and improved GI tolerability profile, celecoxib may offer advantages over conventional non-selective NSAIDs in the treatment of acute ankle sprain. In accordance with current treatment recommendations, patients requiring non-selective NSAIDs, who are at an increased GI risk, should be co-prescribed a gastroprotective agent such as a proton pump inhibitor (PPI). There is evidence that in acute injuries topical non-steroidal anti-inflammatory (NSAI) gels or creams might be as beneficial as oral preparations, probably.<sup>11,12</sup>

#### **Hyaluronic Acid Injection**

The use of hyaluronic acid injection is associated with increased recovery speed and with fewer side effects were reported. But the cost is relatively expensive compared to the standard treatment should be considered. A study that examines the efficacy and safety of periarticular

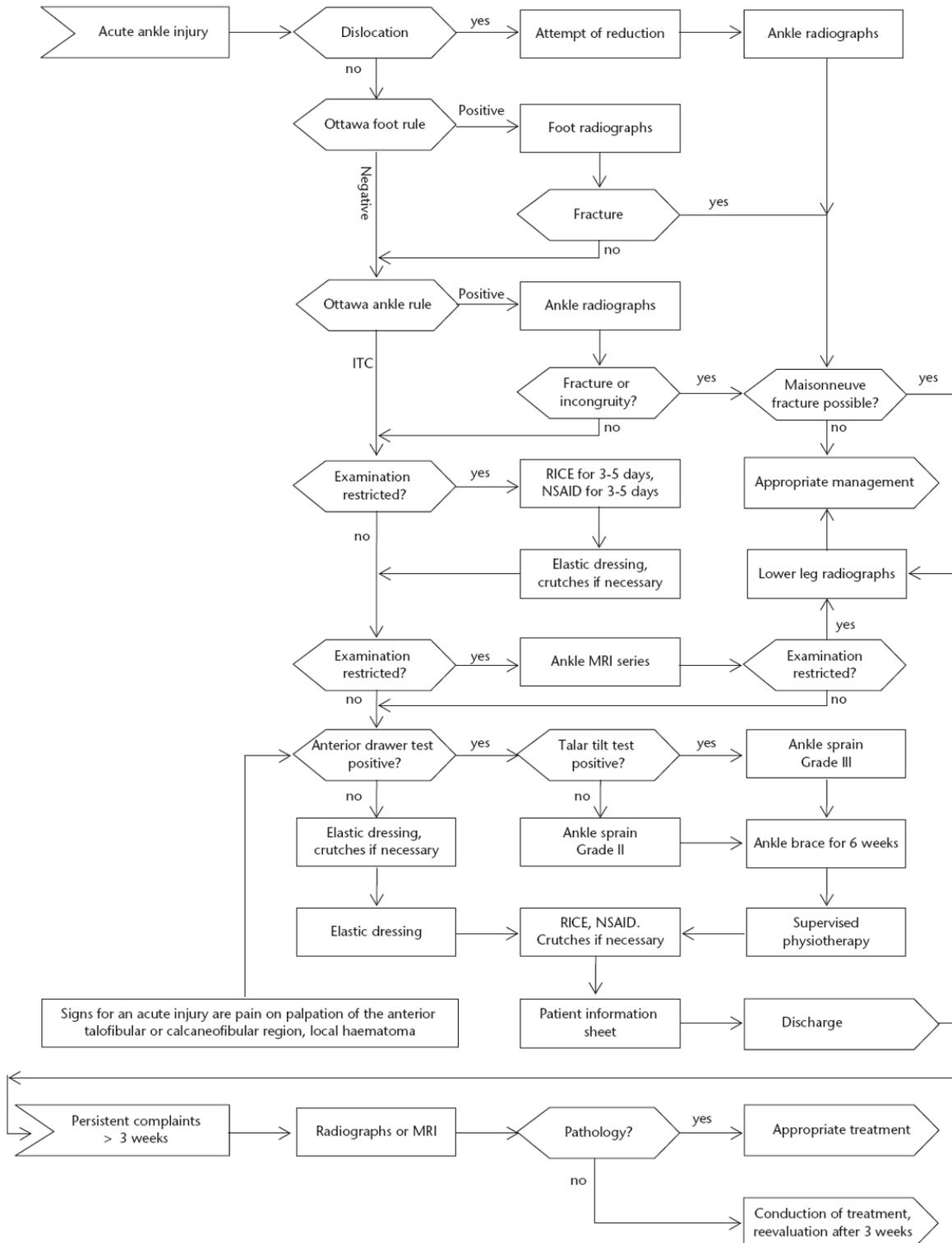


Figure 1. Algorithm for diagnosis and treatment of acute ankle injuries.<sup>8</sup>

hyaluronic acid injections in acute lateral ankle sprain showed that there were significant reductions in pain were seen on the visual analogue score (VAS) is low in activity walking and weight bearing 8 day (and weight bearing alone after 90 days) for the group that received injections of hyaluronic acid compared with placebo injections of normal saline.<sup>13</sup>

### **Surgical**

Most cases of acute ankle sprains can be handled by non-operative methods. A study says that patients with acute ankle sprain given surgical methods have a longer time to return to work compared with patients assigned to conservative treatment. A study also indicates surgery is not helpful in reducing additional complications, cost and risks.<sup>8,39</sup> However, for a Grade III ankle sprains or ankle sprain that has not benefited more than 12 weeks need to get surgery intervention.<sup>40</sup> Pain and stiffness in the ankle that settled, a sensation of instability or giving way and intermittent swelling are suggestive of cartilage damage or impinging scar tissue within the ankle. Arthroscopic repair or ligament substitution is now effective in many cases, allowing a return to full function and sports. Indications for the surgery are usually associated with unstable ankle fractures, OCD (osteochondral defects), loose bodies, or peroneal tendon tears. Based on the best available literature, the evidence-based algorithm shown in Figure 3 summarizes the diagnosis and treatment of acute ankle injuries.<sup>7,8,41,42</sup>

### **CONCLUSION**

Ankle sprain caused by inversion injury that can cause injury to the lateral ligament complex, sometimes followed by tendon injury. The things that facilitate the occurrence of sprains ankle chronic are intrinsic and extrinsic factors. Ankle sprain had 3 main grade according to its grade, severity, pathophysiology and clinical findings, grade I, grade II and grade III. Classification helps in identifying the damage level and correct treatment. The Ottawa Ankle Rules (OAR) were developed to reduce the unnecessary radiographs and decide when radiographic studies are indicated in patients who undergo ankle trauma. Most cases of acute ankle sprains can be handled by non-operative methods. Conservative treatment is very important in the early weeks after the injury. Non-steroidal anti-inflammatory drugs (NSAIDs) in acute phase of ankle sprain may useful. The use of hyaluronic acid injection is associated with increased recovery speed and with fewer side effects were reported. Surgery is not helpful in reducing additional complications, cost and risks. However, for a Grade

III ankle sprains or ankle sprain that has not benefited more than 12 weeks need to get surgery intervention.

### **ACKNOWLEDGMENT**

Authors would like to express gratitude to Director of Sanglah Central Public Hospital, Bali. Thanks to the Head of Orthopedics and Traumatology Study Program of Faculty of Medicine of Udayana University Denpasar and the authors would like to thank to Prof. Dr. dr. I Ketut Siki Kawiyana, SpB, SpOT (K), FICS as supervisor.

### **REFERENCES**

1. Barr K dan Harrast M . Evidence-Based Treatment of Foot and Ankle Injuries in Runners. *Phys Med Rehabil Clin N Am* 16. 2005. 779–799 Department of Rehabilitation Medicine, Box 356490, University of Washington, Seattle, WA 98195
2. Bonnel.F, Tauler, Tourne. Chronic ankle instability Biomechanics and pathomechanics of ligaments injury and associated lesions. *Orthopaedic Surgery and Traumatology Department, Dupuytren Teaching Hospital Center France Accepted: 15 March 2010*
3. Chan K, Ding B, dan Mroczek K. Acute and chronic lateral ankle instability in the athlete. *Bulletin of the Nyu Hospital for Joint Diseases* 2011;69(1):17-26 17
4. Barbara L. Braun, PT, PhD. Effects of Ankle Sprain in a General Clinic Population 6 to 18 Months After Medical Evaluation Institute for Research and Education, Health System Minnesota, Minneapolis. 2009.
5. Juanaidi. Cedera Olahraga Pada Atlet Pelatda PON XVIII DKI Jakarta, Fakultas Ilmu Keolahragaan, Universitas Negeri Jakarta. 2013.
6. Chris M Bleakley, Seán O'Connor, Mark A Tully, Laurence G Rocke, C MacAuley and Suzanne M McDonough. The PRICE study (Protection Rest Ice Compression Elevation): design of a randomised controlled trial comparing standard versus cryokinetic ice applications in the management of acute ankle sprain. *BMC Musculoskeletal Disorders*. Northern Ireland, UK. 2007.
7. C M Bleakley, S M McDonough, and D C MacAuley. Cryotherapy for acute ankle sprains: a randomized controlled study of two different icing protocols. *www.bjsportmed.com*. Northern Ireland, UK. 2006.
8. Al-Mohrej OA, Al-Kenani NS. Acute ankle sprain: conservative or surgical approach? *EFORT Open Rev*.2016;1:34-44. DOI: 10.1302/2058-5241.1.000010.

9. Chook E dan Hegedus Eric J. Orthopedic Physical Examination Test An Evidence-Based Approach. Second edition. Pearson Education. Canada. 2013. Hal 508 dan 529.
10. S H Boyce, M A Quigley, S Campbell. Management of ankle sprains: a randomised controlled trial of the treatment of inversion injuries using an elastic support bandage or an Aircast ankle brace. *Br J Sports Med* 2005;39:91–96. doi: 10.1136.
11. E Cardenas-Estrada, LG Oliveira, HL Abad, F Elayan, N Khalifa, T El-Husseini. Efficacy and Safety of Celecoxib in the Treatment of Acute Pain due to Ankle Sprain in a Latin American and Middle Eastern Population. *The Journal of International Medical Research*. Mexico. 2009.
12. JA Diaz, C Cuervo, AM Valderrama, J Kohles. Valdecoxib Provides Effective Pain Relief Following Acute Ankle Sprain. *The Journal of International Medical Research*. 2006; 34: 456 – 467.
13. Richard Seah, Sivanadian Mani-Babu. Managing ankle sprains in primary care: what is best practice? A systematic review of the last 10 years of evidence. Imperial College Healthcare NHS Trust, London, UK. 2010.
14. Barr K dan Harrast M. Evidence-Based Treatment of Foot and Ankle Injuries in Runners. *Phys Med Rehabil Clin N Am* 16 (2005) 779–799 Department of Rehabilitation Medicine, Box 356490, University of Washington, Seattle, WA 98195.2005.
15. Bonnel.F, Tauler, Tourne. Chronic ankle instability Biomechanics and pathomechanics of ligaments injury and associated lesions. *Orthopaedic Surgery and Traumatology Department, Dupuytren Teaching Hospital Center, France*. 2010. Accepted: 15 March 2010
16. Chan K, Ding B, dan Mroczek K. Acute and chronic lateral ankle instability in the athlete. *Bulletin of the Nyu Hospital for Joint Diseases*.2011;69(1):17-26 17
17. Calatayud J, Borreani S, Colado J. C, Flandes J, Page P. exercise and ankle sprain injuries A Comprehensive Review. Hal 88- 93, vol 42 issue 1, februari 2014, ISSN- 0091-3847. From:<http://www.physsportsmed.com>
18. Chook E dan Hegedus Eric J. Orthopedic Physical Examination Test An Evidence-Based Approach. Second edition. Pearson Education. Canada. 2013. Hal 508 dan 529.
19. Calrk V. A 4-week wobble board exercise programme improved muscle onset latency and perceived stability in individuals with a functionally unstable ankle. *Phys Ther Sport*.2005, 181-187.
20. Driscoll J dan Delahunt E. Neuromuscular training to enhance sensorimotor and functional deficits in subjects with chronic ankle instability: A systematic review and best evidence synthesis. *Sports Medicine, Arthroscopy, Rehabilitation, Therapy & Technology* 2011, 3:19.<http://www.smarttjournal.com/content/3/1/19>
21. Dale B. Functional Rehabilitation After Lateral Ankle Injury . 2006 *Human Kinetics · ATT* 11(3), pp. 52-55
22. Fong D. Understanding acute ankle ligamentous sprain injury in sports. *Sports Medicine, Arthroscopy, Rehabilitation, Therapy & Technology*.2009, 1:14 doi:10.1186/1758-2555-1-14 Received: 9 July 2009, Accepted: 30 July 2009 from: <http://www.smarttjournal.com/content/1/1/14>© 2009 Fong et al; licensee BioMed Central Ltd. 92
23. Farquhar W. Muscle Spindle Traffic in Functionally Unstable Ankles During Ligamentous Stress. *Journal of Athletic Training*. 2013;48(2):192–202, doi: 10.4085/1062-6050-48.1.09, by the National Athletic Trainers' Association, Inc, from: <http://www.natajournals.org>
24. Hartel J. Functional Instability Following Lateral Ankle Sprain. Department of Kinesiology, Pennsylvania State University, University Park, Pennsylvania, USA. *Injury Clinic Sports Med*. 2000; 29 (5): 361-371.
25. Hale F, Axmacher, Kiser. Bilateral improvements in lower extremity function after unilateral balance training in individuals with chronic ankle instability. 2014; 49 (2) : 181-91.
26. Hertel, J. Functional Anatomy, Pathomechanics, and Pathophysiology of Lateral Ankle Instability. *Journal of Athletic Training* , 37 (4), 2002. 364-75.
27. Hale S dan Hartel J. Reliability and Sensitivity of the Foot and Ankle Disability Index in Subjects With Chronic Ankle Instability. *J Athl Train*. 2005 Jan-Mar; 40(1): 35–40. PMID: PMC1088343
28. Hyeyoung K, Chung F, Hee Lee B, A Comparison of the Foot and Ankle Condition between Elite Athletes and Non-athletes. 2013. 20. 25 (10) : 1269-1272.
29. Han K dan Ricard M. Effects of 4 Weeks of Elastic-Resistance Training on Ankle-Evertor Strength and Latency, *Journal of Sport Rehabilitation*, 2011, 20, 157-173, 2011 Human Kinetics, Inc
30. Hupperets, Varhagen, Van M. Effect of unpervised home based proprioceptive training on recurrences of ankle sprain randomized controlled trial. *BMJ*, 2009:339.

31. Kisner C dan Colby L Alen. Therapeutic Exercise Foundations and Techniques. Sixth Edition. F.A Davis Company.America. 2012. hal 850-859.
32. Lynch.S.A. Assessment of the Injured Ankle in the Athlete. Athl Train. 2002 Oct-Dec; 37(4): 406–412. PMID: PMC164372
33. Mattacola, Carl G dan Dwyer, Maureen K. Rehabilitation of the Ankle After Acute Sprain or Chronic Instability, Journal of Athletic Training. 2002. Hal.413–429 by the National Athletic Trainers Association Inc. From : [www.journalofathletictraining.org](http://www.journalofathletictraining.org) 93
34. Martin R, Daven P, Stephen P, Wukich D, Josep. Ankle Stability and Movement Coordination impairments: Ankle Ligamen Sprains. Clinical Practice Guidelines Linked to the International Classification of Functioning, Disability and Health From the Orthopaedic Section of the American Physical Therapy Association. J Orthop Sports Phys Ther. 2013;43(9):A1-A40. doi:10.2519/jospt.2013.0305
35. Maffulli dan Longo. Focus On Lateral ankle instability, British Editorial Society of Bone and Joint Surgery. 2013.
36. Miller Jude A Proprioceptive Training & Its Implications on Ankle Rehabilitation . 2011.
37. NIAMS, Sport injuries, p. 2, 2010 ([http://www.niams.nih.gov/Health\\_Info/Sports\\_Injuries/default.asp](http://www.niams.nih.gov/Health_Info/Sports_Injuries/default.asp))
38. Pocock, J.Stuart. Clinical Trials: A Practical Approach. Chichester. John Wiley & Sons.p. 2008.
39. Sherwood, Lauralee. Fisiologi Manusia Dari Sel Ke Sistem. Edisi 6. Jakarta. 2009.
40. Thompson C, dan Page P. Treating Chronic Ankle Sprains in Sports Founding Member of the Christian Sports Medicine Association. 2009. From:<http://www.iasportsperformance.org> March 2009.
41. Wees P. Lessen A, Hendriks E, Dekker J, Bie Rob. Effectiveness of exercise therapy and manual mobilisation in acute ankle sprain and functional instability. Department of Epidemiology, Maastricht University, Royal Dutch Society for Physical Therapy (KNGF) 3University Medical Centre Australian Journal of Physiotherapy. 2006 Vol. 52 hal : 27-37
42. Young C,. Clinical Examination of the Foot and Ankle of Sports Medicine, Medical College of Wisconsin, 9200 W Wisconsin Avenue, Milwaukee, WI 53226, USA. 2005.

