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Musculoskeletal Disorders Especially Sprain their Various Effects and Possible Effective Therapies in Modern Age

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ABSTRACT

Musculoskeletal disorders (MSDs) are characterized by damage to the locomotive system, including muscles, bones, ligaments, joints, tendons and nerves often caused by extrinsic factors including trauma, psychosocial factors and high biomechanical exposure. These disorders mostly affect individuals' routine work and productivity, leading to absenteeism and early retirement, as treatments are costly, leading to prolonged individual suffering. The occupational group that is particularly affected by this disorder is teachers; here its prevalence is higher than in other professions due to the tough routine, physical load and demands of their work. Sprains, particularly ankle sprains, are one of the most common musculoskeletal injuries around the world, especially in athletes and physically active persons. In terms of sports-related trauma, ankle injuries rank next to knee injuries. Male and female athletes exhibit distinctive patterns in the incidence of ankle sprains. These disorder leads to severe socioeconomic loss especially in developing countries. This review provides an overview of the diagnosis of MSDs, including MRI and sonography, the most efficient methods of diagnosis. The effective treatment includes cryotherapy, drug-based treatment, and the PRICE protocol which have been discussed along with advanced treatment methodology including PRP and shockwave therapy.

INTRODUCTION

MSDs are some of the common human health disorders primarily involving the human skeletal framework, muscles, tendons, ligaments and cartilages and in some cases the human nervous system. It also restricts the locomotive system which could be mild to severe – leading to disability. There are two classification of this disorder – acute and chronic where the latter is fatal and highly dangerous to health (Bell-Starr & Ingram, 2024). This disorder is associated with teaching years, gender, age range (Vega-Fernández et al., 2021), weight, students socioeconomic status, classroom infrastructure, workplace environment and psychological state (Radwin et al., 2001). It is established that there is a correlation between the employment area (urban or rural) of a teacher and the prognosis of a disease. This disorder has been researched earlier based on the category of the nations into developed, underdeveloped and developing ones; by body divisions: neck, lower back, shoulder and upper limbs. The literature reveals that worldwide the primary antecedent for this disorder is jobs and working hours. This also leads to extended sick leaves and pre- and rapid retirements known as WMSDs, work related musculoskeletal disorders (Punnett & Wegman, 2004). According to the ILO, 154 million deaths and 220 million incapacitating illnesses result from work-related health conditions, while 2.78 million people die from work-related' accidents or fatalities every year. Worldwide, work-related injuries result in socioeconomic loss, equivalent to approximately 3.9% of the world's gross domestic product, 472.7 billion euros and non-fatal diseases, 1,207.5 billion euros of fatal diseases. Thus it can be justified that the major and most significant contributing factor towards MSDs is

work life together with the related activities (Scott, 2017). WMSDs are reported to be the most reported complaints in workplaces and long-term work-related back pain is ranked fourth in Disability Adjusted Life Years in 2019. Employees in underdeveloped and developing nations lack control mechanisms to realize they are affected by occupational hazards. Lack of sufficient protective measures, ergonomically disadvantaged daily workplace rhythm and poor physical environment aggravate those risks and result in this disability (Ponkilainen et al., 2019). Ligament's major function is to position one bone at the other one. The stretching and even tearing of the ligament is the mechanism of the sprain. Some of the characteristic features of a sprain include swelling, formation of a diffuse black and blue zone, ease with tenderness at the part and pain during the manipulation of the part. There is a fine line between a fracture and a sprain, as strain, as opposed to stress, causes damage to muscles or tendons. Over two million sprains are treated annually in the emergency departments of the US and UK (Doherty et al., 2017).

Sports-related ankle sprains are some of the most frequent injuries and their frequency depends on the type of sport while showing an irregular fluctuation when comparing male and female athletes. This is not a confirmed pattern in many studies while comparing the incidences of athletic stress, particularly in sports such as the ankle strain rates between male and female athletes. However, in 2017, an epidemiological study showed that the current rate of ankle sprain injury in males is higher than in females. However, in the same year there was another study that reported that the incidence rate of ankle sprains in male and female elite soccer players is the same. Different works described the high frequency of such injuries and often repeated variability in the patients with a single first ankle sprain (Ponkilainen et al., 2019) whereas over 40% of the patients who sustained lateral ankle sprains described above still experienced these chronic symptoms, including chronic ankle sprains and lateral instability. The review article primarily compares epidemiology its risk factors, preventive measures, and some potentially new techniques to diagnose and treat the condition.

Ankle sprains pathophysiology

Ankle sprains can cause significant short-term morbidity, recurred injuries and functional instability. They are most common in hospital emergency rooms, sports medicine clinics and first-contact clinics. However, in 95.2% of cases, satisfactory results of treatment can be achieved through nonoperative methods; accurate assessment of the injury at the time of first presentation is crucial in order to minimize the possibility of recurrent instability. Proper management can prevent or minimize the extent of a long-term adverse outcome such as chronic recurrent ankle instability, arthritic progression and long-term disability. Ankle sprains typically only affect the ATFL or CFL, though they can occasionally affect both ligaments. The mechanism of injury (high- or low-energy damage), foot position and rotational force on the joint and stabilizing ligaments are further factors used to categorize ankle sprains. It is claimed to be the cause of 31% of football-related injuries and 45% of all basketball-related injuries. Each year, 302,000 new patients with ankle sprains and 42,000 new patients with severe ankle sprains attend accident and emergency rooms in the UK. Concerning peripheral sprains in Western countries, it has been estimated that one ankle sprain per 10,000 of the population occurs every day. In the sports setting, the incidence is even higher. Rates of sprained ankle 16-21% of all sports-related injuries. X-rays are taken in 77-99% of these injuries. Of these, a fracture of the ankle About 85% of the sprained ankles involve the lateral ligament complex, out of which 65% are strictly involving the ATFL, 20% involving both the ATFL and CFL and less than 10% involving the PTFL. These individuals have functional instability, repeated injuries and short-term morbidity (Carto et al., 2019; Polzer et al., 2011).

- Low grade ankle sprains are lateral ankle ligament sprains. About 90–95% of ankle sprains are "low" ankle sprains with the ATFL (anterior talo-fibular ligament) being the most often injured ankle ligament.
- High grade Ankle sprains, fractures or both can result in syndesmotic injuries. According to reports, 1–18% of patients with ankle sprains experience "high" ankle sprains.

Table 1

Grades of Ankle Sprain and its Physical Examination

	Examination	Treatment
Grade I	Minimal tenderness and swelling	Physiotherapy
Grade II	Moderate tenderness and swelling, Decreased range of movements	Surgical reconstruction
Grade III	Significant tenderness and swelling, Instability	Weight bear as tolerated

The set of 33 joints, sometimes referred to as ankle joints are formed by the 26-foot bones and the long bones of the lower limbs. Foot mobility is made possible by the ankle complex, which is made up of the talocalcaneal (subtalar), tibiotalar (talocrural) and transverse-tarsal (talocalcaneonavicular) joints (Brockett & Chapman, 2016). As a synovial hinge joint, the ankle can grow or contract in volume in response to pathologic diseases like degenerative osteoarthritis or hemarthrosis (Draeger et al., 2009).

Lateral ligament complex

About two-thirds of ankle sprains are caused by solitary tears of the ATFL, which is the weakest ligament. Compared to the level of the talar insertion, tears are more common at the fibula's enthesis. Furthermore, the

most frequent cause of persistent ankle instability is injury to the ATFL (Colo et al., 2023; Herzog et al., 2019) On the axial MR scans, PTFL appears as a trapezoid between the talus and the medial surface of the lateral malleolus. The medial surface of the fibula's lateral malleolus is where the anterior and posterior fibers of the PTFL originate (Gursoy et al., 2015). Calcaneofibular ligament (CFL) – The most versatile aspects of CFL were its size, shape, orientation, and capsular relationship. 66% showed a solid, cord-like shape, whereas 34% showed a flat, fanning-out structure. In 68% of cases, the CFL was found to be an extra-capsular structure, while in 32%, it was found to be a capsular reinforcement. Inversion in a neutral or dorsiflexed position is primarily restrained by it (Lacerda et al., 2023; Matsui et al., 2017).

Medial deltoid ligament

Tibiospring (TSL), tibionavicular (TNL), and tibiocalcaneal (TCL) make up medial deltoid ligament.

Distal tibiofibular syndesmosis ligaments

There are three fibrous structures, the anterior inferior tibiofibular ligament (AITFL), posterior inferior tibiofibular ligament (PITFL) and interosseous tibiofibular ligament (ITFL).

Low ankle sprains

Acute ankle or low-grade sprains are one of the most frequent musculoskeletal injuries and have a particularly high prevalence among highly active adults. Additionally, acute ankle sprains have a high recurrence rate, which is connected with the development of chronic ankle instability (Herzog et al., 2019; Waterman et al., 2010). In a clinical setting, patients will describe an abrupt ankle twist. Compared to people without a rupture, those who have a lateral ligamentous rupture report more acute edema and are more likely to have to stop their activities (D'Hooghe et al., 2018). Talocrural plantarflexion and subtalar inversion are two components of the LAS mechanism. The talus's narrower posterior dimension interacts with the ankle mortise in this posture, decreasing the talocrural joint's bone stability (Golanó et al., 2016).

Reduced ankle proprioception, diminished ankle dorsiflexion range of motion and impaired balance are the most important intrinsic risk factors for LAS. These elements may make it more difficult for the peroneal tendons, which operate as dynamic ankle stabilizers, to respond to changes in ankle position and increase the risk of injury to the lateral ankle ligaments (Chen et al., 2019). Injuries to the lateral or medial ligament complex are referred to as 'low ankle sprains' and are very common.

High ankle sprains

Low-grade ankle sprains are far more prevalent than "high ankle sprains," which are injuries to the distal tibiofibular syndesmosis. Ankle dorsiflexion and/or external rotation are the most frequent mechanisms of high ankle injuries. Athletes are more likely to get these high-energy injuries than mild ankle sprains (D'Hooghe et al., 2018). The development of CAI, which is characterized by laxity and mechanical instability that impair activity is linked to the high rate of reinjury following an acute lateral ankle sprain. Following an initial ankle sprain, repeated injuries to the same tissue, or other causes, chronic ankle instability can arise and eventually result in insufficiency of the lateral ankle ligament complex (Attenborough et al., 2014; Herzog et al., 2019).

Table 2

Factors involved in Ankle Sprain progression

Factors	Modifiable	Non-Modifiable
Intrinsic Factors	Limited ankle joint range of movement (ROM)	Female sex
	Reduced proprioception	Previous history of ankle sprain
	Postural imbalance	Physical characteristics, i.e. height, foot posture index, anatomical abnormalities
	High body mass index (BMI)	
Extrinsic Factors	Type of sport practiseda Shoe wear such as high heels	Male athletes

Evaluation

If particular criteria are met, the Ottawa ankle regulations advise getting ankle radiographs for individuals who are having malleolar pain. These include the inability to bear weight for four steps during evaluation and shortly following the injury, as well as soreness around the posterior edge or tip of the distal 6 cm of the lateral or medial malleolus. Additionally, if there is soreness at the base of the fifth metatarsal, tenderness over the navicular bone or an inability to bear weight both during the evaluation and soon following the injury, a set of foot radiographs is recommended for patients experiencing midfoot pain. By following these rules, needless radiographs are decreased and proper imaging is ensured (Kerkhoffs et al., 1996).

Cost of Health care in Sprain

High direct and indirect medical expenses result from ankle sprains. According to study, the projected expenses for each acute ankle sprain in the US range from 318 to 914 USD. Each sprain is thought to cost 360 euros in the Netherlands. These expenses are projected to be 684 euros per injury. As patients age, costs rise, especially for home care, rehabilitation and ambulance treatment. Patients with minor injuries can now see their general practitioner 24 hours a day, 7 days a week, thanks to new standards that were introduced in the Netherlands. As a result, fewer people with ankle sprains went to the ER (de Boer et al., 2014).

Tests for Detection

- **Anterior drawer test:** Young but physically active people are more likely to suffer from anterior cruciate ligament (ACL) ruptures, which can cause instability, meniscal tears and damage to the articular cartilage. It is commonly used for patients having supine, with the hip and knee being flexed to 45° and 90°, respectively. For this purpose, gentle pressure is being applied to the proximal tibia to measure the displacement in a flexed knee (Makhmalbaf et al., 2013).
- **Talar tilt test:** Traditionally, only manual procedures, including the talar tilt and anterior drawer tests, have been used in clinical settings to evaluate the ankle complex's mechanical laxity. Talar tilt test, which is also useful for detecting talocrural and subtalar joint laxity (Rosen et al., 2015).
- **Squeeze tests:** It is used to evaluate syndesmosis. At the midcalf, the tibia and fibula are compressed. When it causes discomfort the test is considered positive (Ehrlichman et al., 2017).

Modern Diagnostic Approaches of Sprain detection

While examining you, your doctor will also feel for and possibly note any signs of inflammation or areas that are painful in your affected limb. At practice, they found that localizing commercial offered pain and its intensity can give a clue about the extent and type of the occurrence. Further, the involvement of bone structures can be excluded with a negative result on an X-ray and it will help to establish a diagnosis based on other findings. MRI also pointed out that there should be an extensive use of MRI in order to assess the lesion in the damaged area.

MRI: A common method for evaluating muscle damage is magnetic resonance imaging (MR) imaging. MR imaging is frequently used to evaluate muscle injuries, allowing for the simultaneous assessment of osseous and soft tissues, especially in high-performance athletes. It is becoming more and more crucial in determining the extent of an injury and directing an injured athlete's return to play (Flores et al., 2018)**.** Ankle lateral ligaments can be seen on MRI and a diagnosis with a sensitivity of 75–100% can be achieved. Predicting the future clinical progression of osteoarthrosis or chronic instability is challenging, though. According to a prospective series of sprained ankles, 27% of patients had bone bruising. Even though MRI showed a high sensitivity and specificity when compared to arthrography employing anterior and posterior syndesmosis, the clinical significance of a bone bruise on MRI remains uncertain and does not require treatment. Although MRI can show ligamentous damage to the ankle, its usage is restricted due to its high cost, high frequency of injured ankles and limited availability (Breitenseher et al., 1995).

Sonography

Ankle joint tendons, such as the Achilles tendon or the peroneal tendons, can be evaluated for ruptures or displacement using ultrasound. However, not much research has been done on ultrasound's capacity to identify ankle lateral ligament damage (Benjamin et al., 2006). Using MRI as the gold standard for sonographic evaluation in 20 patients, with a sensitivity of 92% and a specificity of 83% for ATFL damage and rupture. At arthroscopy, sonography was verified in 34 individuals with a 100% sensitivity and a 33% specificity. Sonographic evaluation, however, heavily relies on the technician's skill. Furthermore, in order to evaluate ligament integrity, cutting-edge tools and diagnostic methods are required. Additionally, the number of patients in the observational study is modest (level III) and sensitivity varies greatly depending on the individual ligaments implicated. As a result, it is not included in the usual processes (Sofka & Pavlov, 2001).

Treatment

Cryotherapy: Since cryotherapy is usually used in conjunction with other treatments, its effectiveness in treating soft tissue injuries—especially sprains—has been understudied. Nonetheless, it appears to lessen swelling and the need for pain medication, especially when taken shortly after the injury and as such, it ought to be a part of the first routine regimens. Additionally, it increases the clinical examination's dependability. There is still debate on the frequency, duration and method of applying ice. Recommendation: A limited sample size was examined over the first three to five days following an acute soft tissue injury and it was determined that cryotherapy lowers pain and oedema (Van Dijk et al., 1996).

Drug Based Treatment: Ogilvie-Harris conducted an analysis of eighteen RCTs and were done by the fact that using NSAIDs decreases pain at short-term follow-up (Khoshbin et al., 2013). We did not find more evidence that any specific NSAID was superior or inferior to any of the others (diclofenac, ibuprofen, piroxicam, diflunisal, celecoxib). Their review gave fairgrounds for believing that patients treated with NSAIDs had a shorter hospital stay and less postoperative pain. Most other RCTs and systematic reviews revealed moderate differences in favor of NSAIDs regarding short-term follow-up of pain. However, few of the RCTs did not find significant differences between the groups receiving NSAIDs and placebo for short-term follow-up. There haven't been any notable changes thus far, although there is some proof that comfrey root ointment may also assist to improve the symptoms in the short term. Treatment

with hydrolytic enzymes was no more successful than treatment with a placebo. NSAIDs reduce pain during the short-term follow-up. They should be used for three to seven days in addition to cryotherapy to treat acute ankle injuries (Dupont et al., 1987).

Figure 1

Chemical structure of two NSAIDS

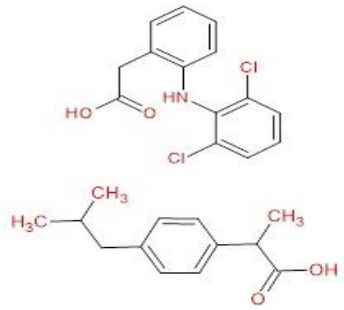
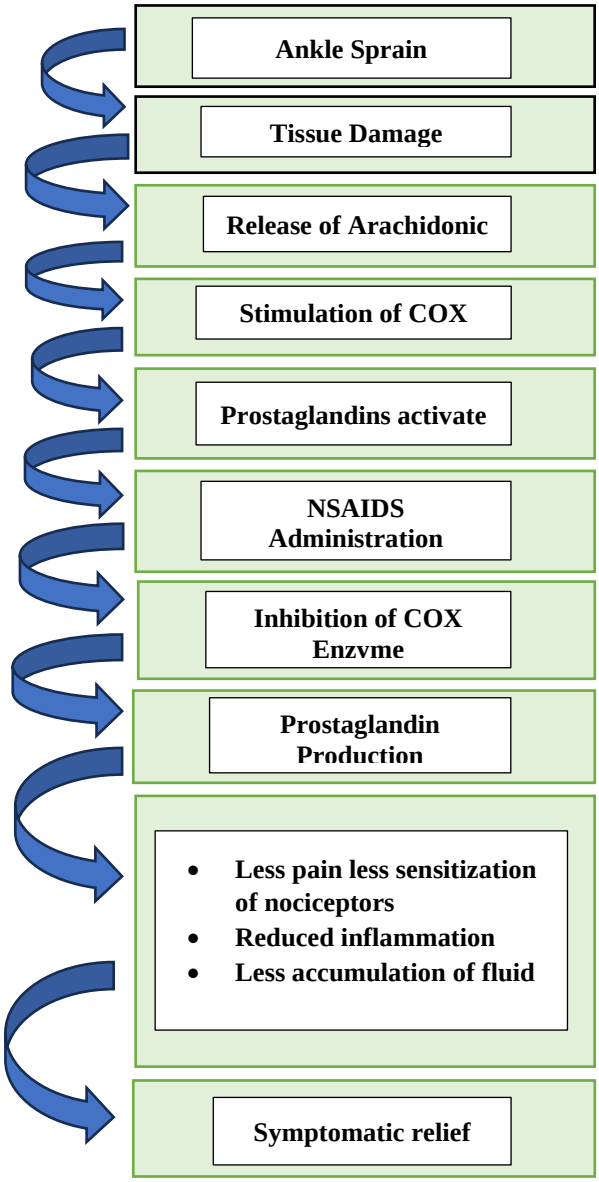


Figure 2

Action Mechanism of NSAIDS for treatment of Sprain



Other Treatment

The RICE protocol—which stands for rest, ice, compression and elevation—should be used for minor ankle injuries. For the first 72 hours, it is likely appropriate to avoid loading on the damaged ankle and then gradually resume activities. First, if a doctor prescribes crutches, one can use them if the agony is too great protocol (elevation, compression, ice, rest, and protection). It makes sense to rest the damaged ankle for the first 72 hours and then gradually resume activities as tolerated. Crutches might be used initially for comfort if necessary. When compared to the conventional method of immobilization the outcomes of early weight-bearing with support (elastic compression wrap or a walking boot, air cast or walking cast) have been shown to be superior: return to sports, return to work, persistent swelling, range of motion and patient satisfaction. An elastic bandage, any shoelace support around the ankle or any semi-rigid or pneumatic support can all be used to create compression. In order to reduce the swelling that is typical of the injury, the injured ankle should also be elevated above the level of the heart as much as possible during the first 24 to 48 hours. Since smothering raises the risk of infection, range-of-motion exercises can be started once the pain and edema have subsided. Acetaminophen or non-steroidal anti-inflammatory medications can be used for analgesia (Wight et al., 2017).

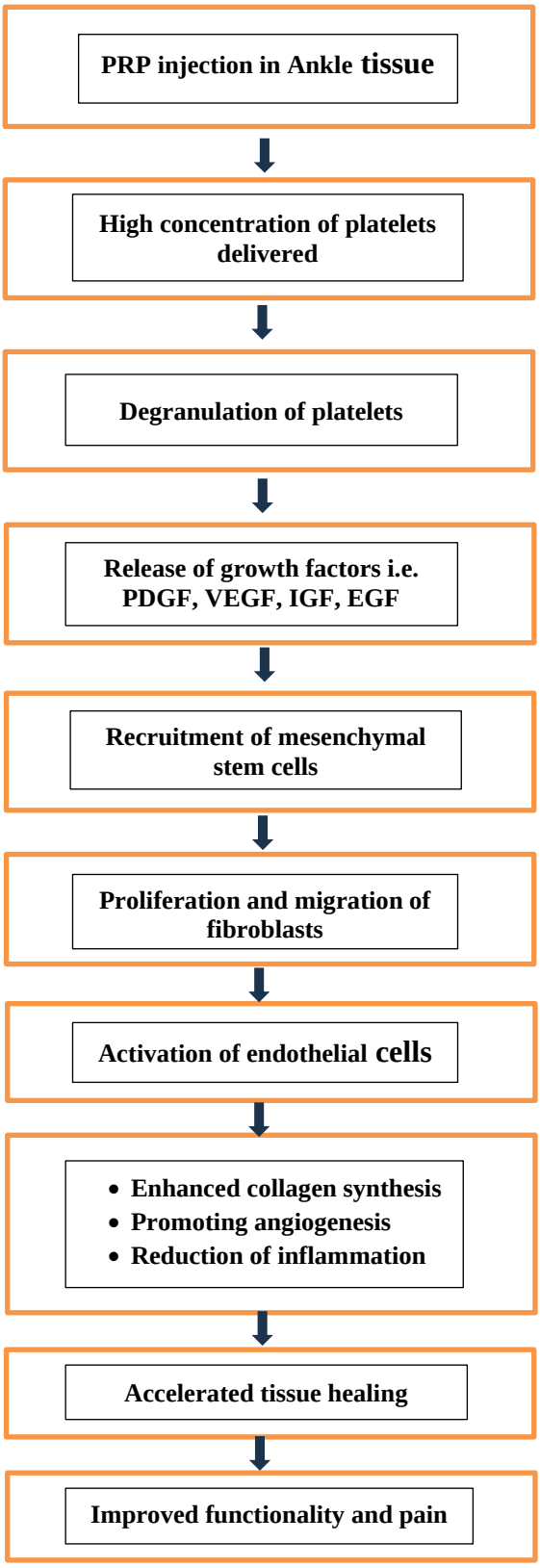
Advanced Therapies in Ankle Sprain

Platelet-rich plasma (PRP) is an autologous concentrate of the patient's own blood that induces higher than physiological levels of growth factors in cases of chronic pathology in attempt to speed up healing. Growth factors stored in the alpha granules of platelets include factors that induce chemotaxis or movement, cell proliferation, differentiation, angiogenesis and the synthesis of extracellular matrix. PRP is slowly moving its way up the field of sports and rehabilitation medicine and its participation in many soft injuries has only recently been explored. Nevertheless, its low understanding left little known about the role of PRP research in the LAS treatment. In a case of LAS with complete tear of the ATFL that provided complete healing and early stability of the ankle after PRP. Similar study also proved the use of PRP in moderate ankle sprains, that the PRP injection group had minimum pain scores and better functional scores than control group at 8 week, but a similar trend was found in patient treated with or without PRP at 24 week (Frey et al., 2024). The beneficial effects of PRP on tendon matrix production and gene expression have been shown in a number of recent investigations. PRP-cultured equine tendon explants showed elevated cartilage oligomeric matrix protein, type I collagen and type III collagen gene expression without a rise in the catabolic molecules MMP-3 and MMP-13. According to a different study, equine flexor digitorum tendons

cultivated in PRP had greater levels of TGF-β and PDGF-BB than those of other blood products (Halpern et al., 2012; Vinod et al., 2022).

Figure 3

Plasma Rich Platelet in Treatment of Sprain



Shockwave Therapy

More recently, extracorporeal shock wave therapy (ESWT) is employed in the treatment approach of the musculoskeletal-medical pain. The application of ESWT to patients with chronic Achilles tendinopathy. But, to date, there is no proven evidence that demonstrates its advantages to patients with CAI. It is created using electrohydraulic, electromagnetic or piezoelectric techniques. They exert a primary mechanical effect that targets specific areas and secondary cavitation effects that may cause tissue damage. In human bone marrow stromal cells, physical shockwaves cause membrane hyperpolarization and Ras activation for osteogenesis. Through the recruitment of mesenchymal stem cells and the production of TGF-β1 and VEGF, shockwave encourages bone repair (Lee et al., 2022; Wang, 2012).

Futures Perspectives

Some questions that clinicians (general practitioners, physical therapists, rehabilitation medicine specialists and sports medicine specialists) who treat and counsel patients with ankle sprains may find interesting Incorporate if an exercise therapy tool, such the Wii FitTM, can be added to the traditional exercise rehabilitation program for physical therapy in patients with ankle sprains and whether it can be included as an alternative in the traditional treatment regimen toolbox. In rehabilitation interventions, future studies should demonstrate the advantages of utilizing new technologies that provide patients with acute lateral ankle sprains or CAI with an enticing and customized treatment plan. Traditional routine physical therapy exercise regimens may benefit from the use of virtual reality training programs such as Nintendo Wii FitTM for both acute ankle sprains and CAI populations. When it comes to training time and extra sports-related activities, virtual reality exercises are more expensive for patients than APK physical treatment. Future research on ankle sprain and CAI should additionally ascertain the results of fibular alignment, trigger point dry needling and upper extremity postural control. The premise that cerebral sensorimotor integration and processing problems accompany CAI justifies the prescribed technique when prescribing postural control exercises for the upper extremities. Taping may be used to realign the femur and dry needling is advised to address trigger points and their negative effects. In addition to ratings like return to sport for athletes, other evaluation techniques can include ordinal clinical measures like edema, range of motion, muscle strength and functional tests (stability, walking and bouncing). The danger of re-injury, which is currently as high as 12 I.M. Punt and L. About 34%, is another issue that needs to be considered for the future. Additionally, since patients aged 15 to 19 have the highest incidence of ankle sprains, only youngsters will be compared among therapies. Last but not least, considering that cost-effectiveness studies come after the examination of the therapeutic advantages and effectiveness of the various treatments, FE may need

to assess and improve the performance of diverse exercise programs.

CONCLUSION

Evaluated the robustness of the present research and found distinctive patterns impacting the diagnosis and treatment of acute ankle sprains while contrasting the somewhat unclear and inconclusive current literature. The Ottawa Foot and Ankle Rule can be used to reduce the quantity of X-rays to the lowest feasible level. If the diagnosis of soft tissue disorders is the goal, a physical examination is sufficient. Classifying injuries into stable and unstable categories seems to be the most practical and important strategy. If the symptoms do not go away or there is a possibility that the syndesmosis is injured, an MRI should be performed. Ankle lateral ligament injury now responds best to functional treatment, which includes rest, protection, ice, compression, elevation, non-steroidal anti-inflammatory medications, immediate weight bearing and mobility exercises, both active and passive. Patients with acute, subacute and chronic injuries of classes II and III should be administered a semirigid ankle brace along with rehabilitation. Only in cases where the patient presents with chronic instability is surgical therapy recommended. The results of the studies to date indicate that this method works well for treating acute ankle injuries. The process of deciding which kind of diagnostic technique is best and what kind of treatment to employ is somewhat aided by the obvious algorithm creation.

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