Clinics in Surgery

Research Article
Published: 15 Jun, 2017

Surgical Treatment of Peroneus Brevis Tendon Repair with and without Human Amniotic Allograft: A Comparison Study

J Joseph Anderson[1], Adebola T Adeleke[1], Brittany Rice[2] and Zflan Swayzee[1]*

[1]Department of Podiatric Surgery, American Foundation of Lower Extremity Surgery and Research, Alamogordo, NM, USA

[2]Department of Podiatric Surgery, Scripps Mercy Hospital, San Diego, CA, USA

Abstract

Surgically repairing peroneus brevis tendon tears include postoperative complications such as adhesions, which is concerning given the period of postoperative immobilization. The use of human amniotic allograft (HAA) has been found to have anti-microbial, anti-fibrotic, anti-inflammatory, and analgesic properties. These benefits may help decrease postoperative adhesions and pain. All patients included in the study (129) were surgically treated for longitudinal peroneus brevis tendon tear. The procedure included the Triad procedure (ankle arthroscopy, lateral ankle ligament reconstruction, and peroneal retinacular tightening), tubularization of the tendon, and debridement of low lying peroneus muscle belly, if present. Some patients (58) had their repair augmented with HAA, while others (71) did not. There was no significant between the two groups in terms of gender, age and modified American College of Foot and Ankle Surgeons hindfoot and ankle scores preoperatively or pain scores preoperatively. There was significance in postoperative physical therapy times between the control group (7.01 weeks) to the graft group (5.21 weeks) ($p<0.001$). Mean postoperative visual analog scales between the human amniotic allograft and control group were 1.24 and 1.62 respectively and also rendered statistically significant ($p<0.001$). The authors found the use of human amniotic allograft to be a viable and effective adjunct in peroneal tendon repair with reduced postoperative pain, physical therapy time with minimal or no associated complications.

Keywords: Tendon repair; Triad procedure; Dehydrated placental allograft

OPEN ACCESS

Correspondence:
Adebola T Adeleke, Department of Podiatric Surgery, American Foundation of Lower Extremity Surgery and Research, 2301 Indian Wells Dr. Suite A, Alamogordo, NM, 88310, USA, Tel: 5754340639; Fax: 5754344148; E-mail: taaadeleke@gmail.com

Received Date: *09 May 2017*
Accepted Date*: 08 Jun 2017*
Published Date*: 15 Jun 2017*

Citation:
Anderson JJ, Adeleke AT, Rice B, Swayzee Z. Surgical Treatment of Peroneus Brevis Tendon Repair with and without Human Amniotic Allograft: A Comparison Study. Clin Surg. 2017; 2: 1515.

***Copyright** © 2017 Adeleke AT. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.*

Introduction

Peroneus brevis tendon tears often present as lateral ankle pain and instability caused by mechanical or anatomical factors. Since first reported by Myers in 1924, its prevalence today is not always considered. Longitudinal peroneus brevis tears have been reported to be between 11% and 37% with significant lateral ankle injuries [1-4]. Tears of the peroneus brevis tendon are frequently overlooked leading to misdiagnosis and mistreatment. Dombek et al. [5] found that only 60% of peroneal tendon disorders were accurately diagnosed at first visit. Tears and ruptures are commonly associated with other disorders including chronic ankle instability, inversion ankle sprains, tenosynovitis, and ankle fractures [6,7].

Proper treatment of these injuries requires an understanding of potential anatomical abnormalities that may contribute to this pathology. The anatomical position of the peroneus brevis tendon predisposes the tendon to shear stress due to its location between the distal fibula and the peroneus longus tendon [8]. A flat or convex retro-malleolar groove, low lying muscle belly, peroneus quartus, rearfoot varus, procurvatum ankle, posterior lateral fibular spurring, and superior peroneal retinaculum incompetence are additional anatomical abnormalities that can contribute to weakening of the peroneus brevis tendon [2,5,9-12].

Surgical treatment options for peroneus brevis tendon tears may include one or more of the following: primary repair of the tendon, debridement, excision of tendon with tubularization, tenodesis, tendon transfer, lateral ankle ligament reconstruction, repair using allograft, peroneal sulcus deepening, or superior peroneal retinaculum repair [2,6,13-17]. More than one procedure is often performed to sufficiently address the tear and its concurrent anatomical abnormalities as mentioned above.

Human amniotic allograft (HAA) is a commercially available product that is composed of human amniotic membrane. Although the use of HAA in peroneal tendon repair has been minimally reported in the literature, it is well documented in its use for many other clinical procedures. Over the past 100 years, HAA has been used in chronic wounds, burns, tendon repair, nerve repair, corneal repair, intra-oral reconstruction, hip arthroplasty, microvascular grafts, genital reconstruction, peritoneal reconstruction, dural defects, skin reconstruction, intra-abdominal adhesions, talar dome lesions, calcaneal osteotomies, and reconstruction of nasal lining and tympanic membranes [18-24]. Several studies have shown that HAA contains an array of growth factors, cytokines and proteins that contribute to its analgesic, anti-microbial, and anti-inflammatory properties [18-20,25-27]. The primary glycosaminogly can present in amniotic allograft is high molecular weight hyaluronic acid, which has been shown to decrease adhesions and fibrosis; therefore, helping with the reduction of scars [18-20,23,25,28-31]. HAA is immunologically inert, eliminating the risk for host rejection. Each tissue specimen undergoes a thorough screening process for relevant communicable diseases and is sterilized [32]. The pluripotent property of the cells found in human amniotic allograft allows for potential regeneration into different tissue types such as cartilage, bone, muscle, or tendon [19,21,27]. All of these qualities of HAA have made it a suitable product for a variety of foot and ankle pathologies.

There are currently no outcome studies on surgical treatment recommendations for peroneus brevis tendon tears. Publications on the use of allograft in the treatment of peroneal tendon tears are also sparse and limited to a few published case reports. The purpose of this study is to report comparative outcomes of peroneus brevis tendon tear repairs using human amniotic membrane allograft versus a control group without HAA and to present any significant differences found. The authors hypothesize that the analgesic, anti-microbial, anti-inflammatory and adhesion reducing properties of HAA will result in functional preservation, reduced rehabilitation time, reduced postoperative pain, minimal complications and increased patient satisfaction as opposed to control group.

Patients and Methods

A total of 368 ankle arthroscopy cases that underwent the Triad procedure were reviewed from January 2006 to May 2013. Each patient was treated operatively by a single surgeon (JJA). All patients with talar osteochondral defects, peroneus longus pathology, previous ankle surgery, diabetes, BMI over 30.1, subtalar joint pathology and inadequate follow-up were excluded. The final patient cohort consisted of 129 consecutive Triad cases, 58 with HAA used at the peroneus brevis repair site and 71 without (control). All patients had history of injury to the ankle with continued pain, instability, and inability to perform regular activity including exercise and sports. All patients failed conservative care that included bracing, NSAIDS, rest, and immobilization a minimum of 4 weeks of physical therapy. Patients received physical therapy preoperatively and postoperatively. The operative procedure included a peroneus brevis tendon repair using tubularization, and excision of low lying muscle belly with the Triad surgical procedure, which consists of ankle joint arthroscopy, lateral ankle ligament reconstruction and peroneal retinacular tightening [33]. The human amniotic allograft was then wrapped around the peroneus brevis repair site prior to repair of the peroneal retinaculum in the HAA group. Primary outcomes were patient satisfaction using a preoperative and postoperative visual analog scale (VAS), and modified American College of Foot and Ankle Surgeons (ACFAS) hind foot ankle score system. The ACFAS score was modified for radiographic findings, which were converted to neutral points preoperatively and postoperatively. The modified ACFAS score was measured preoperatively as well as 3, 12 and 24 months postoperatively. A paired T-test was used to determine statistically significant findings between the preoperative and postoperative scores.

Figure 1: Curvilinear incision placement on lateral ankle.

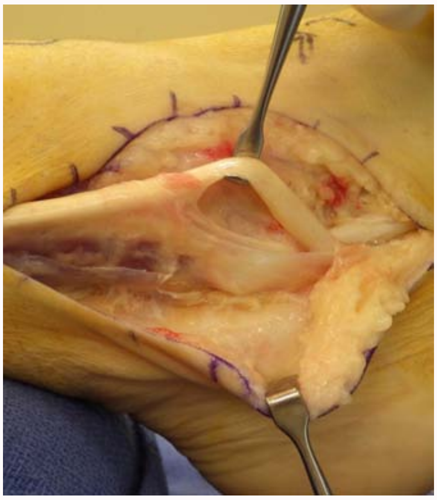

Figure 2: Peroneus brevis tendon tear prior to repair.

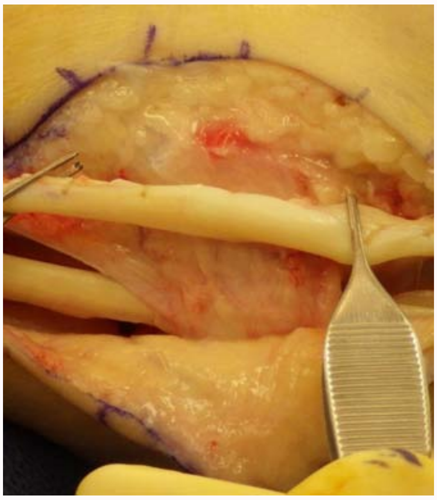

Figure 3: Peroneus brevis tendon after repair with direct tubularization.

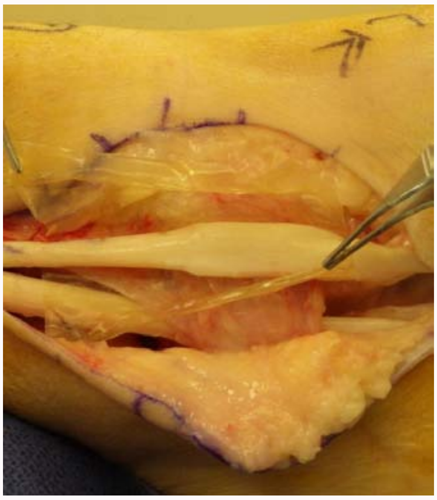

Figure 4: Peroneus brevis tendon with human amniotic membrane allograft.

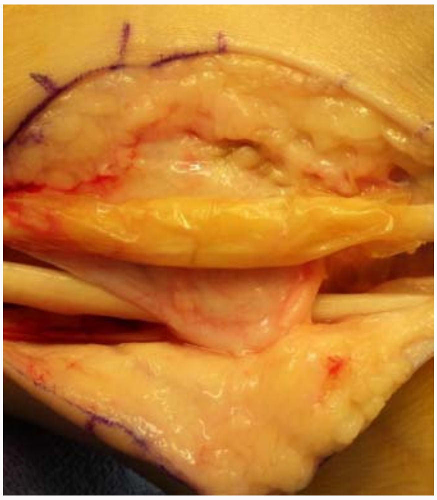

Figure 5: Human amniotic membrane allograft wrapped around the repaired peroneus brevis tendon.

Surgical technique

A standard anterior, lateral and medial ankle scope portal approach was used. Any superficial chondritis, anterior lipping or anterior pinch lesions were addressed. An 8 cm curvilinear incision was made over the lateral portion of the ankle beginning 5cm posterior to lateral malleolus and curving distally anterolateral to incorporate the lateral portal and then posteriorly below the tip of the fibula for the lateral ligament exposure (Figure 1). The incision was deepened through soft tissue down to the level of the peroneal tendons. The peroneal retinaculum was entered proximal to allow reattachment and periosteum on the fibula to sew to. No anchors were used. Any presence of a low-lying peroneus brevis muscle belly, accessory tendon, and/or synovitis and redundant retinaculum were excised. The longitudinal tears were repaired with direct tubularization of the brevis (Figure 2 and 3).

In the HAA group, human amniotic allograft* was wrapped around the brevis and the peroneal retinaculum was re-approximated and tightened. The peroneal tendons were then returned to their retrofibular groove (Figure 4 and 5). Lastly, the anterior talofibular ligament and calcaneofibular ligament were imbricated, repaired and reinforced with the lateral slip of the extensor retinaculum. Skin was closed in standard fashion with vicryl and nylon suture. An identical procedure was performed in the control group without the use of HAA.

NuShield protective patch, Nutech Medical, Inc., Birmingham, AL.

Results

The average ages of the HAA and control groups were 38.36 and 39.24 years, respectively. The sex of the patients were fairly evenly split between males and females in the HAA (M=36, F=22) and control (M=49, F=22) groups. The age ranges for the two groups were 18-70 for the HAA group and 18-68 for control group. In both groups, patients had comorbidities of hyperthyroidism, thyroid disease, hypertension, diabetes and obesity. One additional patient had coronary heart disease in the control group (Table 1).

Pre and postoperative VAS scores were 6.0 and 1.2 respectively in the HAA while the control group had scores of 6.0 and 1.6. The pre-operative HAA and control VAS Score were not significantly different ($p=.89$) but post-operative VAS scores were ($p<0.001$) (Table 2).

The ACFAS scores were measured pre-operatively and post-operatively at 3 months, 12 months and 24 months for every patient. The average score for the HAA group was 72.69 pre-operatively, 89.42 at 3 months post-operatively, 91.46 at 12 months post-operative and 91.31 at 24 months post-operatively. The average score for the control group was 72.08 pre-operatively, 87.50 at 3 months post-operatively, 90.08 at 12 months post-operative and 89.23 at 24 months post-operatively. There was no significance between the pre-operative scores of the HAA group and control group, but there was significant improvement between the 3 month, 12 month and 24 month post-operative scores, ($p<0.001$, $p<0.001$, $p<0.001$ respectively). When pre-operative to post-operative comparisons were made, the differences seen between HAA and control group was significant ($p=0.012$) (Table 2).

HAA patients had a mean postoperative physical therapy time of 5.21 weeks while control group subjects exhibited mean physical therapy of 7.01 weeks, also a significant difference ($p<0.001$) (Table 2).

Postoperative complications (4.65%) included one patient who developed complex regional pain syndrome and another who experienced nerve entrapment in HAA group while two subjects developed nerve entrapments in the control group and 2 more with tissue scarring (Table 1).

Discussion

The results of the present study have demonstrated promising outcomes for the use of HAA in surgical procedures to repair peroneus brevis tendon tears. With a significant reduction in postoperative pain and physical therapy time, minimal complications, and zero postoperative infections, the results are consistent with prior publications showing that the use of HAA in foot and ankle procedures is safe. Since its first use in skin transplantation in the early 1900s, there have been several studies showing its utility and safety in foot and ankle surgeries [18,19,21-27]. Demill et al. [18] published a retrospective study reporting the short-term outcomes of cryopreserved amniotic membrane and umbilical cord tissue in foot and ankle surgery. The authors reported 20 different surgical

Table 1: Patient Demographics.

Demographics	Age: Average	Age: Range	Sex	Comorbidities		Complications	
Procedure with Human Amniotic Allograft	38.36	18-70	F=22	15	Patients	2	Patients
				9	Hyperthyroidism	1	CRPS
				3	Thyroid Disease	1	Nerve Entrapment
			M=36	2	Obese		
				1	Diabetes Mellitis		
Procedure without Human Amniotic Allograft	39.24	18-68	F=22	20	Patients	4	Patients
				12	Hyperthyroidism	2	Nerve Entrapment
				3	Thyroid Disease		
			M=49	3	Obese	2	Scar Tissue
				1	Diabetes Mellitis		
				1	Coronary Artery Disease		

Table 2: Modified ACFAS and VAS Scores.

ACFAS and Vas scores	Modified ACFAS Scores				VAS Scores		Physical Therapy	
	Pre - OP	3 Month Post - OP	12 Month Post - OP	24 Month Post - OP	Pre - OP	Post - OP	Pre - OP	Post - OP
Procedure with Human Amniotic Allograft	72.69	89.42	91.46	91.31	6.09	1.25	6.24	5.25
Procedure without Human Amniotic Allograft	72.08	87.5	90.08	89.23	6.12	1.81	6.09	7.35
					p=0.8991	p=0.0002	p=0.7584	p<0001

procedures that involved the use of amniotic allograft, with the most common procedure performed being Achilles and peroneal tendon repair. Of the 129 patients, the overall wound complication rate was 4.65% with only 2.3% having continued pain at surgical site. The authors found that the complication rate was much lower than what was historically noted [18]. Anderson et al. [21] found that using HAA in addition to micro-fracture for treatment of talar dome lesions also helped decrease postoperative pain. In a retrospective study, 37 patients with osteochondral lesions measuring 2 cm^2 or less were treated with micro-fracture and HAA. VAS scores and modified AFCAS ankle scores were recorded preoperatively and postoperatively and the authors reported a statistically significant improvement in these scores with no identified complications. Another study by Anderson et al. [24] reported the safety of HAA in calcaneal osteotomies, which included 63 patients undergoing an Evans calcaneal osteotomy with implantation of tri-cortical iliac crest bone graft. The authors retrospectively reviewed all 63 patients with a 2 year follow up and found that the use of HAA did not increase the time to union or return to normal shoe gear for this procedure. There were no documented wound dehiscence, nonunion, infection, or immune reactions reported. Warner et al. [29] examined the safety and efficacy of cryopreserved amniotic membrane and umbilical cord in 14 patients undergoing complex reconstructive and/or revision foot and ankle procedures. While the study sample was small, the outcomes showed no complications directly related to the use of the allograft, as well as a statistically significant improvement in pain and function via the ACFAS score.

The results of this study have also have shown that the use of HAA significantly improved pain as demonstrated by the decreased VAS scores and physical therapy time. Within the HAA group, significant ACFAS scores substantiate the efficacy of human amniotic allograft in affecting patient outcomes with improved function and movement at the 3 month, 12 month and 24 month postoperative intervals. Postoperative adhesions in tendon surgery are of concern to any foot and ankle surgeon due to range of motion limitations which may alter the rehabilitation period and lead to continued pain and immobility. The authors feel that wrapping the tendon in HAA made a meaningful contribution to decreasing those complications due to the fact that the subjects in this study who had HAA applied showed significantly improved VAS scores and physical therapy time as opposed to control group.

Conclusion

The clinical use of human amniotic allograft is steadily increasing in foot and ankle surgeries and additional larger, prospective studies will be useful in confirming its niche in the field. In conclusion, the present study has added to the growing body of research demonstrating the utility and safety of human amniotic allograft in foot and ankle surgery, specifically peroneal tendon repair. With its anti-microbial, anti-inflammatory, anti-fibrotic properties, human amniotic allograft affords numerous benefits to peroneal tendon repairs including pain reduction, shorter physical therapy utilization and minimal complications. HAA can prove to be an effective, cost sensitive adjunct in surgical repair of peroneal tendon repairs.

References

1. Sobel M, DiCarlo EF, Bohne WH, Collins L. Longitudinal splitting of the peroneus brevis tendon: an anatomic and histologic study of cadaveric material. Foot Ankle. 1991;12(3):165-70.
2. Sobel M, Geppert MJ, Warren RF. Chronic ankle instability as a cause of peroneal tendon injury. Clin Orthop Relat Res. 1993;296:187-91.
3. Sobel M, Bohne WH, Levy ME. Longitudinal attrition of the peroneus brevis tendon in the fibular groove: an anatomic study. Foot Ankle. 1990;11(3):124-8.
4. Freccero DM, Berkowitz MJ. The relationship between tears of the peroneus brevis tendon and the distal extent of its muscle belly: an MRI study. Foot Ankle Int. 2006;27(4):236-9.
5. Dombek MF, Lamm BM, Saltrick K, Mendicino RW, Catanzariti

AR. Peroneal tendon tears: a retrospective review. J Foot Ankle Surg. 2003;42(5):250-8.

6. Heckman DS, Reddy S, Pedowitz D, Wapner K, Parekh SG. Operative Treatment for Peroneal Tendon Disorders. J Bone Joint Surg Am. 2008;90(2):404-18.
7. Clarke HD, Kitaoka HB, Ehman RL. Peroneal tendon injuries. Foot Ankle Int. 1998;19(5):280-8.
8. Major NM, Helms CA, Fritz RC, Speer KP. The MR imaging appearance of longitudinal split tears of the peroneus brevis tendon. Foot Ankle Int. 2000;21(6):514-9.
9. Meyers AW. Further evidence of attrition in the human body. Am J Anat. 1924;34:241-67.
10. Krause JO, Brodsky JW. Peroneus brevis tendon tears: pathophysiology, surgical reconstruction and clinical results. Foot Ankle Int. 1998;19(5):271-9.
11. Sobel M, Geppert MJ, Olson EJ, Bohne WH, Arnoczky SP. The dynamics of peroneus brevis tendon splits: a proposed mechanism, technique of diagnosis, and classification of injury. Foot Ankle. 1992;13(17):413-22.
12. Geller J, Lin S, Cordas D, Vieira P. Relationship of a low-lying muscle belly to tears of the peroneus brevis tendon. Am J Orthop (Belle Mead NJ). 2003;32(11):541-4.
13. Raply JH, Crates J, Barber A. Mid-substance peroneal tendon defects augmented with an acellular dermal matrix allograft. Foot Ankle Int. 2010;31(2):136-40.
14. Mook WR, Parekh SG, Nunley JA. Allograft reconstruction of peroneal tendons: operative technique and clinical outcomes. Foot Ankle Int. 2013;34(9):1212-20.
15. Ozbag D, Gumusalan Y, Uzel M, Cetinus E. Morphometrical features of the human malleolar groove. Foot Ankle Int. 2008;29(1):77-81.
16. Steel MW, DeOrio JK. Peroneal tendon tears: return to sports after operative treatment. Foot Ankle Int. 2007;28(1):49-54.
17. Demetracopoulos CA, Vineyard JC, Kiesau CD, Nunley JA 2nd. Long-term results of debridement and primary repair of peroneal tendon tears. Foot Ankle Int. 2014;35(3):252-7.
18. DeMill SL, Granata JD, McAlister JE, Berlet GC, Hyer CF. Safety Analysis of Cryopreserved Amniotic Membrane/Umbilical Cord Tissue in Foot and Ankle Surgery: A Consecutive Case Series of 124 Patients. Surg Technol Int. 2014;25:257-61.
19. Niknejad H, Peirovi H, Jorjani M, Ahmadiani A, Ghanavi J, Seifalian AM. Properties of the amniotic membrane for potential use in tissue engineering. Eur Cell Mater. 2008;15:88-99.
20. Fairbairn NG, Randolph MA, Redmond RW. The clinical applications of human amnion in plastic surgery. J Plast Reconstr Aesthet Surg. 2014;67(5):662-75.
21. Anderson JJ, Swayzee Z, Hansen MH. Human Amniotic Allograft in Use on Talar Dome Lesions: A Prospective Report of 37 Patients. Stem Cell Disc. 2014;4(3):55-60.
22. Gruss JS, Jirsch DW. Human amniotic membrane: a versatile wound dressing. Can Med Assoc J. 1978;118(10):1237-46.
23. Jay RM. Initial clinical experience with the use of human amniotic membrane tissue during repair of posterior tibial and achilles tendons. AFCell Medical. 2009.
24. Anderson JJ, Gough AF, Hansen MH, Swayzee Z. Initial experience with tricortical iliac crest bone graft and human amniotic allograft in Evans calcaneal osteotomy. Stem Cell Disc. 2015;5:11-7.
25. Werber B, Martin E. A prospective study of 20 foot and ankle wounds treated with cryopreserved amniotic membrane and fluid allograft. J Foot Ankle Surg. 2013;52(5):615-21.
26. Zelen CM, Poka A, Andrews J. Prospective, randomized, blinded, comparative study of injectable micronized dehydrated amniotic/chorionic membrane allograft for plantar fasciitis--a feasibility study. Foot Ankle Int. 2013;34(10):1332-9.
27. Zelen CM, Snyder RJ, Serena TE, Li WW. The use of human amnion/chorion membrane in the clinical setting for lower extremity repair: a review. Clin Podiatr Med Surg. 2015;32(1):135-46.
28. Shimberg M. The Use of Amniotic-Fluid Concentrate in Orthopaedic Conditions. J Bone Joint Surg. 1938.
29. Warner M, Lasyone L. An Open-label, Single-center, Retrospective Study of Cryopreserved Amniotic Membrane and Umbilical Cord Tissue as an Adjunct for Foot and Ankle Surgery. Surg Technol Int. 2014;25:251-5.
30. Ozbölük S, Ozkan Y, Oztürk A, Gül N, Ozdemir RM, Yanik K. The effects of human amniotic membrane and periosteal autograft on tendon healing: experimental study in rabbits. J Hand Surg Eur Vol. 2010;35(4):262-8.
31. Koob TJ, Rennert R, Zabek N, Massee M, Lim JJ, Temenoff JS, et al. Biological properties of dehydrated human amnion/chorion composite graft: implications for chronic wound healing. Int Wound J. 2013;10(5):493-500.
32. NuTech Medical (2012) NuCel: Product Overview. 1;1-2.
33. Spencer LK, Anderson JJ, Fowler Z. Ankle Arthroscopy, Lateral Ligament Repair and Peroneal Tendon Reefing for Chronic Lateral Ankle Instability: The Triad versus Arthroscopy with Ligament Repair. Surg Sci. 2015;6:403-11.