



CLINICAL NOTE

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Self-fat injection of surgical failure after a Ledderhose illness. Clinical case

Lipoinfiltración autóloga en un caso clínico de iatrogenia tras enfermedad de Ledderhose o fibromatosis plantar

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Keywords:

Methatarsalgia, Ledderhose illness, plantar fibromatosis, biological therapy, complementary therapy, allografts, platelet rich plasma.

Abstract

Methatarsalgia caused by insufficiency of the plantar pad is the result of several intrinsic and extrinsic factors. The use of self-fat infiltration as a therapy for refilling a tissular deficiency, added to the PRGF-Endoret biological therapy should be considered as an alternative therapy to other options with biocompatible materials, such as xenografts or allografts. This article presents a clinical case of a patient successfully treated by autologous lipoinjection in a loss of plantar fat in the area of the first metatarsal secondary to previous surgery due to Ledderhose's disease. This is a new therapeutic option that could be very useful for the podiatrist in the treatment of this type of cases of localized loss of plantar fat pad.

Palabras clave:

Metatarsalgia, enfermedad Ledderhose, fibromatosis plantar, lipoinfiltración, infiltración grasa, terapia biológica, terapia alternativa, aloinjerto, plasma rico en plaquetas.

Resumen

Diversos factores intrínsecos y extrínsecos pueden provocar metatarsalgias por insuficiencia de la almohadilla grasa plantar. La utilización de la lipoinfiltración autóloga como terapia de relleno del defecto tisular de la grasa plantar junto con el uso de la terapia biológica con plasma rico en plaquetas podría considerarse como una terapia alternativa a las terapias actuales con biomateriales, xenoinjerto y aloinjertos. El presente artículo presenta un caso clínico de un paciente tratado de forma satisfactoria mediante lipoinfiltración autóloga en un defecto de la grasa plantar en la zona del primer metatarsiano secundario a una cirugía previa por enfermedad de Ledderhose. Se trata de una opción terapéutica novedosa que podría ser de gran utilidad para el podólogo en el tratamiento de este tipo de casos de pérdida localizada de almohadilla grasa plantar.

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INTRODUCTION

One of the biggest challenges in Podiatry during the years in the field of metatarsalgia has been the question of how treating those caused by the loss of the plantar fat pad, either caused by the use of high-heel shoes, by migration of this plantar fat pad as a direct consequence of his loss within the pass of the years, or by the cause that brings us the actual case we are focusing in, as a surgery consequence.

The difficulty that contains this technique resided in the fact that the zone that we were going to refill, as it is the one that probably supports more dynamic load in the whole foot.

In the scientific literature there are not many cases of infiltrating refill materials in foot load zones. During the years, xenografts have been used (grafts proceeding of different biological species, in our case, not humans) and allografts (bone or soft tissue transplanted to one person to another), mainly used for treatment of chronic injuries and tendon reparation, but never for increasing the fat tissue in located zones under pressure. In the last years allografts had been used for replacing successfully the tissues in load supporting zones, reducing the previous pain and making easier the walking afterwards, in cases of work/traffic accidents that ended on a loss of the substance¹.

In the last years in podiatry, research has been made in biomaterials (such as hydrogel) for the infiltration in load supporting areas.

But all these techniques are not exempt of the principal risk, which is the strange body reaction and the reject of the graft. The use of the patient own fat, in this case for refilling an area that has lost completely the fat pad, allows us to avoid the use of synthetic or semi-synthetic materials, that can cause complications as described before. In our opinion the self-fat injection can be considered as the best refilling material and the less harmful for the body.

The objective of the present article is to show a clinical case of metatarsalgia for postoperative plantar weight loss that was treated by the use of autologous lipoinfiltration of the patient with biological therapy with Platelet Rich Plasma.

CLINICAL CASE

40 years old patient, male, computer worker, that comes to clinic with significant pain under first toe of both feet that produces an anormal walking.

When questioned about his pathology, tells that the pain began seven years ago (2004). He went to different professionals at the beginning of the pathology, not reaching a precise diagnosis at any moment. As he comments, during the first years of the process, he receives treatment by nitrogen and local necrosating injections.

In 2009 and after several diagnosis examinations, such as RMN and echography, it is diagnosticated with a Ledderhose illness, or plantar fibromatosis in both feet, and the patient pass through a surgery in order to solve this problem, corroborated by the analysis of anatomic pathology. Few months later the pathology appears again, and the surgery has to be repeated.

The post-surgical consequence of this procedures is the complete loss of the plantar fat pad under the first metatarsal support zone of both feet, increased in left foot due to the more aggressive surgery that was made on the second time.

At the time the patient comes to our clinic, he shows a sad, depressive mood, not being able to have a normal life, and with a severe reduction of his life quality. He could not practice sports anymore and refers of having increased his body weight. He also admits having visited another professionals, which told him the possibility of extirpating the tibial sesamoids of both feet, as this was the area that had more trauma.

In the exploration, the patient refers pain at direct touch of the sesamoidal area of both feet, more intensely in the right one. It also presents surgical scars, plantar-medial located in reference to the first metatarsal of both feet which corresponds to the surgical approaching ways, with the specific characteristic that the one in the left foot is adhered to deeper structures. It also presents loss of the plantar fat pad under the sesamoidal area of both feet, consequence of the previous surgeries, with plantar-medial hyperkeratosis in both feet, constant pain in static and an avoiding-pain walking in supination, which causes dynamic varization of the forefoot. It also begins a Morton neuralgia due to all this (Figure 1).



Figure 1. Preop view of the left foot.

Treatment

As an initial treatment we ordered a sylicon muffling adapted orthosis wich gave a significant relief of the symptoms during a few months, but 5 months after, the symptoms came back.

Taking into account the peculiarity of the case, it was decided to meet at a clinical session with several professionals of the Clinica Piqueras' team (Madrid, Spain), taking the option of a offert the patient a new surgical treatment, that consisted in self-fat injection form the abdomen, with the objective of refilling the tissular loss and give back the area all its muffling capacities. The patient was informed of the technique we were going to made, the experimental type of the surgery, advantages and disadvantages.

At first, our goal was an evolution in wich the patient could have controlled walking. By the use of the 3D Podoactiva Scan Sport, global patented, we designed an orthosis with absolutely no type of load from the dyaphisis' middle third of the first methatarsal until reaching the whole length of the first ray, allowing the rest of structures of the foot to support the load, and that could be inserted in flat sole post-surgical shoe. By making this we were sure to make the self-fat infiltrations in both feet at the same time, altering the patient's normal life as less as possible.

At first 3 autologous infiltrations were programmed, number that was to be modificadoed depending on the patient's evolution.

In order to diminish the fat survival problems and the posible post-injection infection problems we decided to use the PRGF-Endoret technology, wich we have been using with great success in podiatric surgery on the last 11 years. The PRGF-Endoret technology consists in a new concept in personalized regenerative medicine. It is based on the making of a 100% self-produced plasma, highly rich in growing factors, whose application in the damaged tissular areas allows to speed the regeneration of a high amount of tissues without any secondary harmful effect², and that is demonstrated to present a bacteriostatic activity against several bacterial strains³.

Growing factors are a substance aggregate that play an important function in the intercellular communication. They perform a great number of biological functions in wich cellular multiplication stands out, but also affect relevantly in the cellular survival, migration, differentiation and even apopthosis. The integration and regeneration process includes a complex amount of biological events controlled by the actuation and collaboration of a mixture of growing factors. There are three agents involved in tissues regeneration: the cellular compound, a combination of several biological go-betweens wich includes growing factors and citokines inter alia, and a matrix or "scaffold" that gives support to the new-construction tissue. After making an injury or a tissular damage they activate and coordinate a high number of intercellular ways in order to regenerate the tissue wholeness ang its hemosthasia. Grow-

ing factors are also needed for promoting the angiogenesis or blood vases formation wich would apport oxygen and nutrients o the damaged tissue. Another essential issue to considerate in tisular regeneration is to develop a struchture or "scaffold" that will act as a temporary extra-cellular matrix and by that way shelter the cells in addition to present locally the biochemical, physical and struchturel signals that will allow the anchorage of the cellular moving enginery⁴.

Surgical procedure

As the only preoperative caution, the patient is told to come on an empty stomach for at least 5 hours. For the obtention of the PRGF-Endoret it is used a simple protocol that begins with a minimum patient's blood volume. A blood extraction is made in 9 ml citrated pipes, that allows the blood to not coagulate. Those pipes are centrifugated during 8 minutes at a 580g speed, giving us the possibility to separate the leucocyte white series and the erythrocythes from the platelet-rich plasma. We separate by the PTD the two fractions of PRGF-Endoret and we keep them isolated until its therapeutical application afterwards.

Once made this blood extraction, the patient will enter the surgery room, beginning the surgery with an anesthetic sedation and a local anesthetic ankle blockage in both feet and also a local anesthetic blockage in the donating area, in this case the periumbilical abdomen area.

Through two small cuts in the umbilical walls it is made a fat-sucking of 50 cc and we proceed to treat it before the injection (Figure 2). Fat passes through a decantation process in order to select the fat for the injection (Figure 3).

In the left foot, the one that suffered the second surgery and that had a sub-scar phybrosis located in the medial sesamoid area, we made a liberation of that phybrosis by the use of a



Figure 2. Fat extraction from the abdomen area.

Beaver 67 MIS scalpel, in order to achieve a better movility of the subdermic and sub cutaneous structure, and the cuts are stitched with a 4/0 monophylament with the objective of not losing any fat compound of the injection afterwards.

Later, we made a fat-injection of 12-15 cc in each feet in the sesamoidal area, making a hypercorrection of the pathology, about a 100 %, assuming that there was going to be an afterwards lost of half percent of the graft (Figure 4).

Once made the fat-injection in both feet, we activate the platelet-rich fraction of the PRGF-Endoret with chlorate calcium for easing the growing factor liberation (Figure 5). After that, we inject in the same area where the fat was infiltrated about 4 CC of activated PRGF-Endoret in both feet in order to give a support and a biological matrix for the self-fat injected graft.



Figure 3. Abdomen fat manipulated before infiltration.



Figure 4. View of the foot post fat infiltration.

After both injections, the one with self-fat graft and the one with PRGF-Endoret, there is an important hypercorrection of the tissular deficiency, wich provokes an important tension on the dermic tissues. We apply a soft local massage for distributing the fat and relieve the tissular tension. A compressive bandage is made up to supramaleolar area and it is allowed the immediate walking of the patient with a post-surgical shoe and an adapted orthosis to the environmental readaptation.

An hour later, the patient is allowed to go back to his home, with antibiotic, analgesic and anti-inflammatory therapy during three days. Walking is not allowed except with the adapted foot and orthosis in order to avoid the pression on the area and the risk of increasing the assumed reabsorption of part of the self-fat graft.

Patient's evolution is highly succesfull from the very first moment, with little discomfort the first days. There are made weekly revisions until the posterior six weeks. In our explorations, we estimate that by that day, 30% of the injected graft remained. So, it was decided to made a second fat-injection with the same procedure of the first surgery, with the only difference that in this time, surgery for the liberation of the sub-scar phybrosis on the left foot was not needed, as it had improved notably from the first treatment (Figures 6 and 7).

The post-op evolution of the second surgery was if possible even better than the first one. The post-op was similar referring to the patient's discomfort, who only tells us a feeling of inner local pression on the first days. The patient is revised weekly, in wich we appreciate a greater integration of the injected fat graft, and also a patient's greater feeling of tissular refilling. Six weeks after the second injection, we give the patient a new pair of orthosis, a thinner ones, wich he can use in confortable but also formal shoes.



Figure 5. Application of PRGF Endoret®.

Due to the obvious clinical improvement, the non-existence of pain of the patient at normal walking and the obvious touch of the tissular refill (60 % of the injected volumen aprox.), it is decided jointly with the patient to wait three months as to evaluate the integrity of the injected fat graft in both feet in this period.

Once passed six months, the patient comes to evaluation, making a biomechanic static and dynamic study. The patient is going on with normal life and his sensations refer no decrease of the volume and refill of the injected fat graft. The biomechanic study shows a more normalized walking, with less forefoot dynamic varization and allowing lightly take-off by the first radium. The patient refers ausence of pain when walking barefoot.

One year after the second injection, patient is re-evaluated. The graft is maintaining his integrity since last injection, the tissular lack has been refilled and the patient repeats the sensation of not decreasing either the volume or the refill of the graft. The biomechanic study (static and dynamic) shows a right foot load, with a normalized dynamics and no pain in the third methatarsal space (morton's neuralgia) wich the patient had in the first visit to our clinic (Figure 8).

According to the patient, we decided to not realize by the moment any other injection and evaluate year by year the evolution and integration of the self-fat injected graft (Table I).



Figure 6. Application of fat in second surgery.



Figure 8. View of both feet 2 years post fat infiltration.



Figure 7. View of the foot post fat infiltration.

DISCUSSION

From 60 years ago, a lot of ways have been described about how to obtain self-fat in order to refill volume lack, either with or without injection from the doning area, with variable negative pressions of sucking the doning area fat, different types of processing de extracted fat by seep, decantation, wash, etc with different results⁵.

In 1950 Peer brings results of a self-fat reabsorption near to 50 %⁶. Matsudo and Toledo observed a reabsorption from 20 to 50% of the fat grats made, that's why they make hyper-corrections of 35% of the necessary volumen to correct the lack⁷. Illouz in 1988 published a survival of only the 20% of the fat and advises to hyper-correct⁸. This cases were made in non-loading body surfaces such as face, that's why we assumed that with no doubt, we would had a bigger

Table I. Clinical evolution		
Year	Patient condition	Treatment
2004	1 st synthomatology	Local necrosating injections
2009	Diagnostic: Ledderhose illness, or plantar fibromatosis in both feet	Surgery
2011 • Diciembre	1 st visit at Clínica Piqueras: – Surgical scars M1 – Loss of the plantar fat pad – Hyperkeratosis – Static pain – Avoiding-pain walking, varization – Morton Neuralgia	Orthosis
2012 • 10 th February	Same synthomatology	1 st autologous infiltrations
• 22 th February	Synthomatology improvement	
• 22 th March	Walking improvement, pain decrease	2 th autologous infiltrations
• 28 th March	Same texture. 60% Presence of the plantar fat	
• 8 th June	Good texture, not pain, walking improvement	No needed
• 29 th June	Good outcome	Orthosis
2013	Maintenement improvement	No needed
2014	No changes	No needed
2016	Maintenement improvement	No needed
2018	Satisfied patient by good outcome	Reinforcement Autologous infiltrations

reabsorption of the injected self-fat, even with the use of the specific orthosis.

Autologous graft's biological properties can on one side stimulate certain cell activity and, on the other side refuse their proliferation, though the patient's satisfaction level is high, in which evolution the low risk of refuse is shown, what is indicated in an effective treatment, in case that there is no contraindication.

Related to other writers as Proubasta, Gil and Planell⁹, they coincide that grafts must possess physical properties as much similar as possible to the substituted material. In addition to that, they point that they must not degrade or cause any reaction to the tissues next to them, as encapsulation or fibrous tissue growing, and they add that must never produce cancer or allergic/inmunological reactions, that's why a proper clinical exam of the patient is needed.

When talking about other biomaterials, Bert and Missika¹⁰ define polymers as synthetic grafts of high molecular weight whose principal inconveniet is the mechanical stress produced by its use and point that those metallics are reactive and can produce several adverse reactions, what means that are few of them that are appropriate.

Nevertheless Soballe, in an Orthopedic Scan Minute, describes ceramycs as inert to body fluids, what places them in a high biocompatibility level, despite its hardness and not ductility, wich makes them fragile.

Regarding the application of growth factors, Fernández-Fairen shows that each case is particular and that the benefit obtained depends on the specific form in which each growth factor is obtained and applied¹¹.

In conclusion, the self-fat injection used as a refill material for methatarsalgia caused by lack of the plantar fat pad must be considered as an effective therapy in those patients that have the adequate conditions. The combined use of the PRGF-Endoret assures us a biological perfect environment and a perfect matrix in wich the self-fat graft can be injected. This graft would be considered the perfect option against xenografts or allografts, taking into account the reject possibility of these last ones. In the same way, it should be noted that each patient in particular, according to their physical and metabolic activity, may need a greater number of injections than any other, and their level of adaptation may be different.

CONFLICTS OF INTEREST

The authors state they have no conflicts of interest.

FINANCING

None.

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