

Degenerative lesions of the plantar fascia : surgical treatment by fasciectomy and excision of the heel spur. A report on 38 cases

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The authors studied 38 cases of degenerative lesions of the plantar fascia which were treated surgically between 1989 and 1999. MRI showed chronic fasciitis in eight cases and an old rupture of the plantar fascia in 30 cases. Surgical treatment, which was performed in all cases after failure of conservative treatment of several months duration, combined excision of the fascia with resection of the heel spur. Histological examination found inflammation in all cases (fasciitis or rupture), calcification of the aponeurosis in four cases, cartilaginous metaplasia in four and fibromatosis in four.

Patients were assessed a minimum of one year and a maximum of seven years after operation. The post-operative results were assessed using three criteria : resolution of pain, results on the static foot and patients' functional activity.

Overall there were 24 very good and good results, nine fair and five poor. MRI performed at the time of follow-up revealed good healing of the plantar fascia in 16 cases, defects in two cases, inflammation in seven cases and defects associated with inflammation in 13 cases.

Surgical treatment may be considered in cases where conservative treatment of talalgia has failed. Symptoms originating from degenerative damage to the plantar fascia, such as rupture or fasciitis, may benefit from fasciectomy. Short-term results show resolution of pain in 75% of cases, and a slight sagging of the plantar arch. Pre-operative MRI study is useful to determine the exact location of the lesions.

INTRODUCTION

Talalgia is a frequently encountered complaint. Its aetiology is varied, precise diagnosis is often difficult, which explains the frequent failure of surgical treatment.

In 1975, Furey (9), in an analysis of 116 cases of chronic lesions of the plantar fascia, noted that two of four cases that had undergone surgical treatment, had made a complete recovery. In 1984, Lester and Buchanan (17) suggested surgery for ten patients, although they were dealing with lesions of the fascia in patients who did not practice sports. Leach *et al* (15) in 1978, and then Snider *et al* (25) and Herrick (10) in 1983 described ruptures of the plantar fascia in top-level sportsmen and women.

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In 1989, Poux *et al* (21) published a series of 30 cases of rupture of the plantar fascia, of which ten successfully underwent surgical intervention. In 1993, Roger *et al* (22) demonstrated the value of Magnetic Resonance Imaging (MRI) for the diagnosis and treatment orientation of lesions of the plantar fascia.

Pasternack and Davison (20) have stressed the value of MRI for the diagnosis of lesions of the musculoligamentous structures of the foot. The presents authors have, since 1989, performed MRIs to study the plantar fascia in patients with talalgia and to select those patients for whom surgery would be considered.

We have performed excision of the posterior one-third of the plantar fascia in 48 feet as described by Christel *et al* (5), and we will present here the 38 cases which have been followed up for a minimum of one year.

PATIENTS AND METHODS

Between 1989 and 1999, 38 feet in 12 men and 26 women were operated by the same surgeon as described below. Twenty right feet and 18 left feet were operated. Patients' ages ranged from 32 to 74 years, with an average age of 50 years. No patient was obese.

All of the patients suffered from talalgia, with localised pain at the anteromedial part of the calcaneus. In four cases pain had initially appeared during sports activities (in two cases running, in one case tennis, and in another soccer). In 34 cases (89%) pain progressively appeared about the calcaneal tuberosity, and was described as a burning sensation in 13 cases and an increasingly intense diffuse pain in 21 cases. These patients reported pain and stiffness in the morning. The pain decreased after a few steps and then became worse again during the day depending on the activity.

In all cases, clinical examination of the plantar surface revealed some abnormality. Palpation over the medial tubercle of the calcaneus produced acute pain in 38 patients.

Eighteen patients had a normal footprint, six had a stage 1 planovalgus foot, two a stage 2 flat foot with a centered hindfoot, two had stage 1 hollow valgus foot, six had a stage 1 hollow foot with a centered hindfoot and four had stage 1 hollow varus foot. Only one patient had a overall decrease in foot mobility.

Standard radiological examination showed a heel spur in 30 cases (79%). In 8 cases there was no radiological anomaly of the large calcaneal tuberosity. The Djian-Annonier angle was between 110° and 120° in 12 cases (32%), between 120° and 130° in 18 cases (47%), and between 130° and 140° in eight cases (21%). The average Djian-Annonier angle was 124°.

On average, patients had been suffering from talalgia for two years before surgery. During that time all had received some form of medical treatment : insoles for at least three months (in 32 cases), one to three infiltrations (in 26 cases) or a systemic treatment with nonsteroidal anti-inflammatory medication (in 24 cases). The duration of previous medical treatment ranged from 4 to 24 months, and was on average 10 months.

An operative indication was made after well-managed medical treatment and based on the results of MRI. Since 1989 all patients presenting with enthesopathy in the hindfoot have been studied with MRI. Only 35% of those pathological MRI scans led to surgical intervention.

The MRI examinations were performed using a high-field system with a superconductor magnet of 1.5 Tesla (Sigma.). A knee type surface coil was used, which gave the possibility for bilateral and comparative exploration.

After axial location, three sequences were performed in the sagittal plane, with a T1-weighted spin-echo technique, a T2*-weighted gradient echo technique, and then, after intravenous injection of Gadolinium. The sections were contiguous and 4mm in width. The duration of the examination was 20 minutes (fig 1).

MRI findings made it possible to define two types of damage to the fascia : in inflammation (fasciitis), the fascia was thickened. The thickening was poorly limited and sometimes accompanied by partial disappearance of the decreased signal of the fascia in the T1 sequence. Continuity was found, however, in the T2* sequence with a moderately increased signal. After injection of Gadolinium, there was a contrast. There were 8 cases of fasciitis in the series, of which two had calcifications (fig 2).

The second type of damage was disruption of continuity of the fascia. This combined an aponeurotic tear, close to the calcaneal insertion of the fascia, and limited thickening, which was usually fusiform and sometimes lamellar. In the T1 sequence, there was a loss of the aponeurotic hyposignal ; the disruption of continuity was clearly shown in the T2* sequence and after injection of Gadolinium, following which there was marked contrast where there had been a recent rupture. This may no longer be noted in cases with an old rupture. Thirty cases of



Fig. 1. — Normal MRI of the plantar fascia



Fig. 2. — Musculo-fasciitis with enthesopathy on T2

disruption of continuity were disclosed: 14 ruptures were centrally located (fig 3a), 16 were located at the heel spur.

The operative approach was through a longitudinal medial incision, at the junction of the plantar and dorsal skin, stopping behind the anteroposterior half of the calcaneus. After detaching the abductor hallucis on the medial side of the plantar fascia, progressive dissection of the plantar surface of the fascia to the posteromedial tubercle of the calcaneus was made. The plantar fascia was incised longitudinally along the lateral side of the abductor hallucis. Its deep surface was freed by gradually detaching the fibres of the flexor digitorum brevis up to its insertion into the calcaneus. The muscle was drawn upwards and backwards by a retractor protecting the lateral plantar neurovascular bundle. The fascia was then explored by palpation in order to locate the pathological area. It was then detached from the posteromedial tuberosity, along with the heel spur, and the pathological tissue was excised as required and following the MRI findings. Closure was achieved over a suction drain. Weight-bearing was allowed after three weeks. The excised tissue was systematically sent to the pathology laboratory.

As Snider (25) has described, lesions found upon examination of the excised tissues could be classified into four stages: The first stage was that of collagen degeneration, with fibres losing their longitudinal arrangement and presenting a haphazard orientation, with an increase in the fibroblastic cellular density. The second stage was

represented by pseudochondroid metaplasia with cells resembling chondrocytes situated within nodules dissociated by oedema. The third stage was that of an inflammatory granuloma with angiofibroblastic hyperplasia corresponding to an increase in vascularisation and a local infiltration by inflammatory cells. The final stage was that of calcifications with patches of acidophilic necrosis in calcified areas.

These lesions were similar to those found in cases of epicondylitis, resulting from repeated microtrauma, which was responsible for the collagen degeneration. Healing did not occur because of the persisting microtrauma. None of our patients was operated on in the acute stage, which probably explains the existence of the chronic lesions we observed.

Pathological examination in our series found inflammatory lesions in all cases (fasciitis or rupture), cartilaginous metaplasia in two, chondroid or osteoid metaplasia in two, fibromatosis in four, microcalcifications in two, and in another two a combination of calcifications and cartilaginous metaplasia.

The 38 patients were reviewed at follow-up by the same examiner a minimum of one year and a maximum of seven years after operation. The average follow-up time was four years.

At the time of follow-up all patients had a radiograph and an MRI scan taken of the relevant foot.

The postoperative results were assessed according to three criteria of Kitaoka (13): the resolution of pain (very good results had no pain, good results had

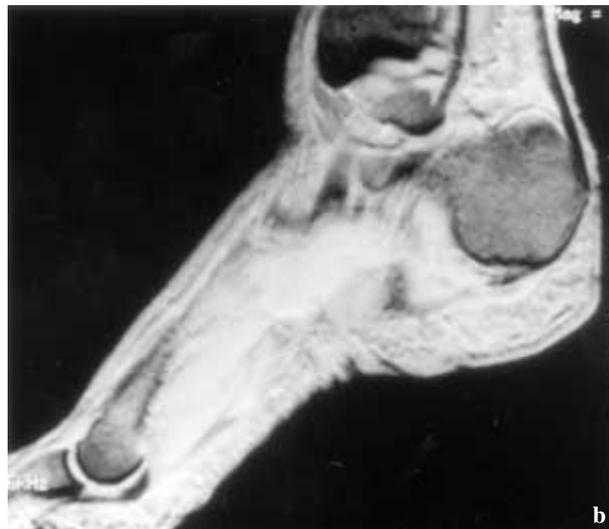
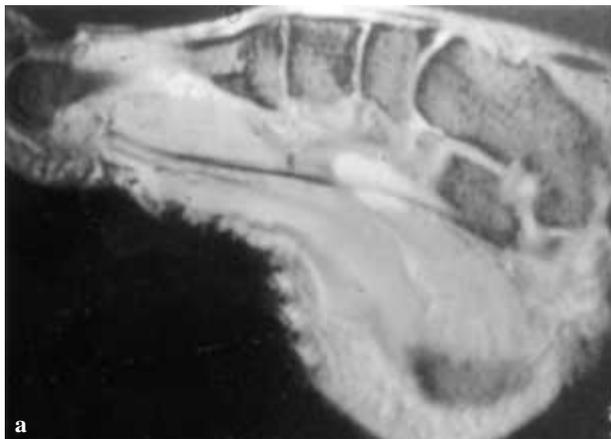


Fig. 3. — a) Rupture of the middle third of the plantar fascia on T2.
b) Enthesopathy with disinsertion of the plantar fascia on T2.

Table I

Score	Pain	Static foot	Functional activity	
			Footwear	Walking distance before pain
0	Permanent, prevents any activity	Secondary flat foot	Slipper	Limited to home environment
1	Limits activity	Slight sagging of the plantar arch	Adapted footwear	Less than half of the normal distance
2	Meteorological	Very light modification	Standard footwear	Equal to or more than the normal distance
3	None	Unchanged	Normal	Normal

persistent discomfort), the statics of the foot (unchanged or modified) and the patient's functional activity. The latter was assessed based upon the ability to wear shoes, the distance the patient could walk before experiencing pain, and his/her home activity. The scores that were obtained (table I) were added to produce an overall result described as very good, good, fair or poor.

RESULTS

Four cases of delayed healing (up to three months) were observed. The average recovery time was two months, with a range from one to three months. In 26 cases, pain when standing upright had disappeared (69%), in two cases the pain was rated as mild (5%), in eight cases pain limited the

activity (21%), and in two cases the pain was permanent and prevented all activity (5%).

Normal footwear was used in 28 cases (73.7%). Comfortable footwear was necessary in ten cases (26.3%). No patient needed slippers or customised footwear. Podiatric examination revealed an unchanged footprint in five cases, of which three retained a normal footprint and two retained a stage 1 flat foot. In 32 cases there was a modified footprint. Of these, in ten cases a normal footprint had changed to show slight sagging of the plantar arch, without reaching a stage 1 flat foot, in five cases a normal footprint had changed to a stage 1 flat foot, in six cases a stage 1 flat foot had changed to a stage 2 flat foot and in 12 cases a stage 1 hollow foot had changed to a normal footprint.

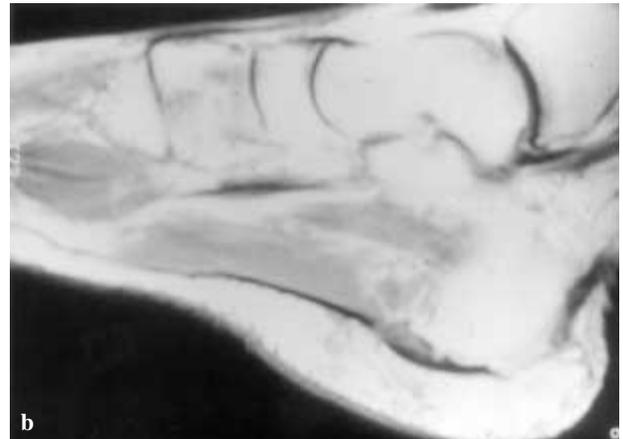
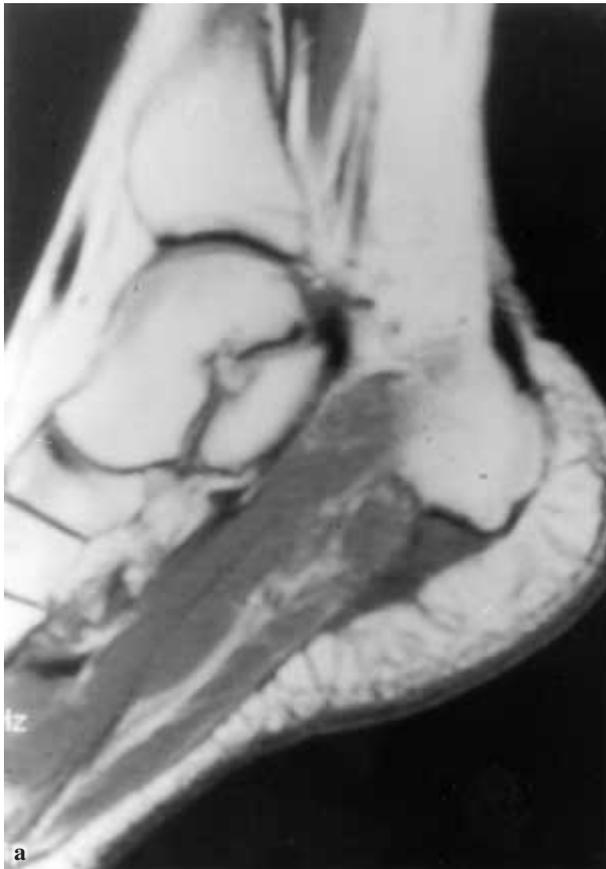


Fig. 4. — a) Postoperative MRI showing continuity of the fascia with, however, a modification of the signal and a slight contrast indicating persistent inflammatory phenomena.

b) Postoperative MRI showing a small defect of a few millimetres, located 0.5 cm from the calcaneal insertion.

In 28 cases the distance patients could walk before the occurrence of pain was normal. In 10 cases this distance was slightly limited, and in two of these cases it was limited to less than half of the normal distance.

Patients were absent from work for a time period ranging from three weeks to eight months. The average time off work was 4 months. Three occupational modifications were noted : one patient was able to work at a desk, two others managed to reduce the distance they were required to walk.

We noted 10 very good results, 14 good results, 9 fair results and 5 poor results. Radiography showed no regrowth of the heel spur. A slight modification of the Djian-Annonier angle was observed. After surgery it was 130°. The average sagging after total fasciectomy was 6°.

MRI showed good quality healing of the plantar fascia in only seven cases. In two cases (16%), it showed almost complete reconstitution of the plan-

tar fascia with evidence of a slight contrast around the insertion, indicating the persistence of a localised inflammatory process. In seven cases (18%), there was an aponeurotic reconstitution around the insertion, with considerable aponeurotic thickening – probably occurring as an after-effect –. In 6 cases (16%) there was no reconstitution of the plantar fascia with a slight contrast at the insertion while in seven cases (18%) there was disappearance of the plantar fascia without any visible focal contrast ; this could suggest an inflammatory process of the area having undergone surgery. In seven cases (18%), there was continuity of the plantar fascia with a slight contrast indicating persistent inflammation in two of them while in two cases (6%) a small aponeurotic defect was noted over a few millimetres in the area having undergone surgery.

DISCUSSION

We share Christel *et al's* view that the heel spur must no longer be considered as the cause of pain but as both an indication of a problem affecting the plantar fascia, and the sign of an existing enthesopathy (5). The systematic presence of a heel spur in our patients accords with this view. Unlike in Christel *et al's* series (5), our patients were mature

subjects, with an average age of 50 years, who had a degenerative lesion causing talalgia. There were only four young subjects, each of whom practised a sport and for whom the lesion was a side-effect of the regular practice of that sport.

Froman and Green (8) have suggested that the formation of the spur results from the compensatory role played by the intrinsic foot muscles in stabilising the foot during abnormal pronation. The abductor hallucis and the flexor digitorum brevis, which partially originate from the plantar aponeurosis, are placed under great tension as they try to stabilise the hypermobile foot. This tension brings about periostitis and then the formation of a spur at the insertion of the plantar fascia into the medial tuberosity of the calcaneus. It appears that in the case of the hypermobile foot both the plantar fascia and the intrinsic muscles play a part in the development of plantar fasciitis.

By showing the type of aponeurotic lesion, MRI enabled us to select the optimal treatment. In the absence of any objective indication of the plantar fascia being affected, conservative treatment is advised. However, the distinction between fasciitis and rupture of the plantar fascia has not altered our surgical standpoint. Unlike Roger *et al* (22), we have not noted that the level of damage (medial or lateral) to the plantar fascia makes any difference.

This series and pathological investigation seem to show that enthesopathies of the plantar fascia do indeed exist. Zingas *et al* (28), have studied the histopathological changes of the plantar fascia in 48 cases of common talalgia. They found degenerative changes in all specimens. In 12% of cases there was infiltration of the fascia with inflammatory cells. There was also damage to adjacent muscles. They found no difference between patients who had had infiltrations and those who had not. These authors advised a medial approach. The plantar approach must be avoided because of painful after-effects.

As Sarrafian has stated (24), surgical excision of the plantar fascia modifies the static plantar arch. Like Salathe and Arannio (23), we have wondered about the responsibility of the plantar fascia in the maintenance of the arch. In fact, the deepest elements, such as the calcaneocuboid ligament, are,

by themselves, capable of ensuring the maintenance of the architecture of the foot, as Poux *et al* (21) have shown through both cadaver dissections and podometric and radiological observations on patients having undergone surgery.

Like Kwong *et al* (14), we think that a tendency towards flat foot is often associated with a lesion of the plantar fascia because the arch is crushed, causing persistent tension on the fascia. Moreover, eight of our patients had a flat foot. The hollow foot is relatively rigid, and poorly adapted to the accumulation of impact stresses from running. Moreover, a hollow foot was found 12 times in our series. The superficial plantar fascia is compared by Kwong *et al* (14) to the string of a bow where tension is increased in the hollow foot.

For Lutter (18), by maintaining the heel for too long in forced supination, the hollow foot prevents the local cushioning provided by the bursa, the curve of the calcaneus and the ligamentous structures of the midfoot. Likewise, the shortening of the Achilles-ankle-plantar system leads to continuous traction on the calcaneal insertion of the superficial plantar fascia.

The role of infiltrations may also be raised as a contributing factor for ruptures of the plantar fascia. Balasubramaniam and Prathap (3) have demonstrated, in experiments on the Achilles' tendon of rabbits, that a local injection of corticoid causes localised necrosis of collagen tissue and predisposes to rupture of the tendon or fascia. There were infiltrations in 26 of our patients. Leach *et al* (16) concluded that injections into the plantar fascia must be avoided.

The pain associated with rupture of the plantar fascia is acute, whilst that involved in musculo-aponeurosis is more progressive, and that of fasciitis is more profound and more insidious in the way in which it appears.

Anderson and Foster (2), in their article on surgical treatments for heel spurs, quote five different authors (Ali (1) ; McBryde (19) ; Snider *et al* (25) ; Tanz (26) ; Ward and Clippinger (27)) having performed a total of 63 plantar fasciectomy without removal of the spur. Of these 61 are rated as excellent or good results, but the follow-up is less than ten years.

Kenzora (11) emphasises the number of post-operative neuromas (15 patients out of 27). These neuromas, all painful and difficult to treat, are due to an inadequate approach to, and dissection of, the posterior elements. The use of mini-incision surgery to try to "rip out" the heel spur seems to be the worst therapeutic solution.

Contompasis (6) has produced a three-year retrospective study of 126 cases of surgery for plantar fasciitis. In 115 cases release of the plantar fascia was performed with removal of the heel spur, whereas in 11 cases, the heel spur was left untouched. The two procedures produced excellent results, but follow-up was only three years.

Surgical treatment is indicated in cases where conservative treatment has failed. For Poux *et al* (21), an old rupture that remains painful after two to three months of well-managed conservative treatment is an indication for surgery. Our results are clearly worse than those in his series, as he reported good results for the 10 patients having undergone surgery with a follow-up time of 26 months. However, the subjects are different, because Poux *et al*'s series (21) is composed only of young subjects having had a traumatic rupture. On the contrary, our series shows degenerative lesions in mature patients with an average of 50 years. Thirty of these lesions developed after a rupture.

Lester and Buchanan (17) recommend simple disinsertion of the plantar aponeurosis. We prefer to release the plantar fascia and to excise its abnormal areas in order to remove the scar tissue which may be at the origin of the pain.

Open surgery is not without complication. There are problems with postoperative healing, pain caused by the wearing of shoes, and neuromas. For these reasons, Barrett *et al* (4), in 1991, suggested that fasciectomy should be carried out endoscopically. At first, this was performed with just one medial approach. Subsequently, the authors have opted for a technique using two approaches. This allows for a better view of the medial anatomical structures with less damage to the tissue than in the original technique. Some studies have showed that endoscopic plantar fasciectomy is associated with less postoperative morbidity and has better functional results, a shorter recovery time and a more

rapid return to normal activity than is the case for open surgery. The series are still too recent to evaluate sagging of the plantar arch after endoscopic intervention.

Fasciectomy allows for better regrowth of the aponeurosis. There is, therefore, less risk of recurrence. This is an area which, with the aid of endoscopy (allowing only fasciectomy), is still open to study. According to Kinley *et al* (12), the ideal instruments of the future would be double cannulas that would allow for partial removal of a portion of the plantar fascia, and would thus reduce the recurrence rate.

The surgical indications and contraindications of endoscopic plantar fasciectomy are the same as for traditional surgery. However, this technique is recommended by the authors for selected patients. Patients must be informed about the aetiology of the syndrome and the relative insignificance of the heel spur. Patients who are unable to understand this message should preferably undergo traditional surgery with exostosectomy.

Endoscopic plantar fasciectomy is a very precise technique, which, in the authors' opinion, must not be attempted without training. The use of endoscopy is still new. Many aspects need to be refined once detailed functional and biomechanical studies have been completed.

However Davies *et al* (7) assert the mainstay of treatment for plantar fasciitis remains nonoperative. In the small percentage of patients who fail to respond to nonoperative treatment over a period of at least 12 months, surgical treatment should be considered. It is essential however, that patients be warned of the potential benefits and limitations of surgery. The operation should be seen as a last resort treatment. If regarded as such, it has an acceptable success rate.

REFERENCES

1. Ali E. Calcaneal spur. *West Indian Med J* 1980 ; 29 : 175
2. Anderson RB, Foster MD. Operative treatment of sub-calcaneal pain. *Foot Ankle* 1989 ; 9 : 317-323
3. Balasubramaniam P, Prathap K. The effects of injection of hydrocortisone into rabbit calcaneal tendons. *J Bone Joint Surg* 1972 ; 54-B : 729-734

4. **Barrett SL, Day SV.** Endoscopic plantar fasciotomy : two portal endoscopic surgical technique – clinical results of 65 procedures. *J Foot Ankle Surg* 1993 ; 32 : 248-256
5. **Christel P, Rigal S, Poux D, Roger B, Witvoet J.** Traitement chirurgical des ruptures de l'aponévrose plantaire. *Rev Chir Orthop* 1993 ; 79 : 218-225
6. **Contompasis JP.** Surgical treatment of calcaneal spurs, a three years postsurgical study. *JAPA* 1974 ; 64 : 987
7. **Davies M, Weiss G, Saxby T.** Plantar fasciitis : how successful is surgical intervention ? *Foot Ankle Int* 1999 ; 20 : 803-807
8. **Forman WM, Green MA.** The role of intrinsic musculature in the formation of inferior calcaneal exostosis. *Clin Podiatr Med Surg* 1990 ; 7 : 217-223
9. **Furey JG.** Plantar fasciitis : The painful heel syndrome. *J Bone J Surg* 1975 ; 57-A : 672
10. **Herrick RT, Herrick S.** Rupture of the plantar fascia in a middle-age tennis player. *Am J Sports Med* 1983 ; 11 : 95
11. **Kensora JE.** The painful heel syndrome : an entrapment neuropathy. *Bull Hosp Jt Dis* 1987 ; 47 : 178-189
12. **Kinley S, Frascione S, Calderone E et al.** Endoscopic plantar fasciotomy versus traditional heel spur surgery : a prospective study. *J. Foot Ankle Surg* 1993 ; 32 : 595-603
13. **Kitaoka HB, Schaap EJ, Chao EYS, An T.** Displaced intra-articular fractures of the calcaneus treated non operatively. Clinical results and analysis of motion and ground reaction and temporal forces. *J Bone Joint Surg* 1994 ; 76-A : 1531-1540
14. **Kwong PK, Kay D, Voner RT.** Plantar fasciitis, mechanics and pathomechanics of treatment. *Clin Sport Med* 1988 ; 7 : 119-126
15. **Leach R, Jones R, Silva T.** Rupture of the plantar fascia in athletes. *J Bone Joint Surg* 1978 ; 60 : 537-539
16. **Leach RE, Dilrio E, Harney RA.** Pathologic hindfoot conditions in the athlete. *Clin Orthop* 1983 ; 177 : 116-121
17. **Lester DK, Buchanan JR.** Surgical treatment of plantar fasciitis. *Clin Orthop* 1984, 186, 202-204
18. **Lutter DL.** La talalgie de l'athlète. In : Claustre J, Bebezis C, Simon L (ed). *Le Pied en Pratique Sportive.* Masson, Paris, 1984, pp 117-122
19. **Mc Bryde AM Jr.** Plantar fasciitis. *AAOS Instr Course Lect* 1984 ; 33 : 278-282
20. **Pasternack WA, Davison GA.** Plantar fibromatosis staging by magnetic resonance imaging. *J Foot Ankle Surg*, 1993 ; 32 : 390-396
21. **Poux D, Christel P, Demarais Y, Parier J, Roger B, Viel E.** Les ruptures de l'aponévrose plantaire. *J Traumatol Sport* 1989 ; 6 : 77-87
22. **Roger B, Christel P, Poux D, Saillant G, Cabanis EA.** Imagerie par résonance magnétique (IRM) des lésions de l'aponévrose plantaire. *J Radiol* 1987 ; 68 : 749-753
23. **Salathe, Arangio GA, Salathe EP.** A biomechanical model of the foot. *J Biomech* 1986 ; 19 : 989-1001
24. **Sarraian SK.** Functional characteristics of the foot and plantar aponeurosis under tibiotalar loading. *Foot Ankle* 1987 ; 8 : 4-18
25. **Snider MP, Clancy WG, Mc Beath AA.** Plantar fascia release for chronic plantar fasciitis in runners. *Am J Sports Med* 1983 ; 11 : 215-219
26. **Tanz SS.** Heel pain. *Clin Orthop* 1963 ; 28 : 169-178
27. **Ward WG, Clippinger FW.** Proximal medial longitudinal arch incision for plantar fascia release. *Foot Ankle* 1987 ; 8 : 169-178
28. **Zingas C, Spjut HJ, Bishop JO, Trevino SG.** Histopathologic changes of chronic plantar fascial disease. A.O.F.A.S. 12th Summer Meeting 27-30, 6, 1996, Hilton Head SC