CASE REPORT

HALLUX RIGIDUS

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ABSTRACT

Hallux rigidus is a common problem of the first metatarsophalangeal joint and is particularly common in the 31–69 year old age group. Loss of articular cartilage narrowing of joint space and formation of periarticular osteophytes are present and increase over time, often leading to palpable osteophyte formation.

The authors suggest that a diagnosis of hallux rigidus be made if at least 4 of the following are present at the big toe: pain, stiffness, palpable exostosis, positive X-ray findings, positive axial grind test, occasional synovitis, decreased motion on motion palpation (particularly dorsiflexion).

This case study follows a 36-year-old male professional tennis player over a 7 year period under various forms of management including orthopaedic, physical therapy and chiropractic care. Initial surgery provided some relief, subsequent physiotherapy did not significantly reduce the patient's pain while chiropractic manipulation and mobilization on two separate occasions provided marked reduction in pain scores. NSAID usage and "punching out" his shoes also provided some relief.

There is a reasonable possibility that general foot and big toe mobilization and the Brantingham "protective" big toe manipulation may reduce the pain of hallux rigidus. A randomized-controlled study should be done to ascertain the efficacy of such a treatment protocol. (J Chiropr Med 2002;1:31–37)

KEY WORDS: Hallux Rigidus; Hallux Limitus; Toe

INTRODUCTION

A stiff painful big toe, or hallux rigidus (HR), is a common problem of the first metatarsophalangeal joint. Next to the bunion or hallux abducto valgus, it is the second most common big toe disorder (1,2,3). Although a few differentiate between hallux limitus (less motion)

and hallux rigidus (ankylosis, fusion, or no motion) (1,4), the majority of authors most commonly use the term hallux rigidus to mean either condition, as will this report. In an epidemiological study of foot conditions Gould reported that in America, 1 out of every 2.5 people suffer a painful foot condition and this author gives specific information regarding the incidence of HR in different age groups (5).

Age group	Male: Female ratio			
4–14 years	1 in 4,500	whites	1 in 1500	blacks 1:1
15–30 years	1 in 300	whites	1 in 50	blacks 1.4:1
31–60 years	1 in 60	whites	1 in 100	blacks 8:1
60+ years	1 in 45	whites	1 in 35	blacks 2:1

Hallux rigidus thus appears most often in the 31–69 year old age group, it occurs much more frequently in males than females, and it is reported by Nawoczenski (2) to affect 1 in 45 individuals 50 years and older. But of interest to practitioners interested in sports injuries, hallux rigidus is reported as the most common injury of the big toe in athletes (3). With an increase in sports activities for females and the general public these specific figures may have increased.

Hallux rigidus is apparently a degenerative arthrosis that varies from a periarticular fibrosis to bony ankylosis and from osteochondritis (Frieberg's infarction) to osteonecrosis (6,7). There is, over time, loss of articular cartilage, narrowing of the joint space and formation of periarticular osteophytes and often palpable dorsal osteophyte formation (2).

Natural History and Prognosis

The natural history and prognosis, although not specifically delineated in terms of time, is generally described below. According to Lorimer, in the early stages there may be impaired function (decreased range of motion) without pain during gait, or a "functional hallux rigidus" (4). In later stages movement continues to decrease because of degeneration, and with eventual marked loss of range of motion the pain becomes less severe. A compensatory antalgic gait may occur (walk-

ing on the lateral side of the foot or secondary supination) and cause pain in other areas of the foot due to abnormal weight bearing. Plantar calluses, helomata ("corns") and compression and even deformity of the lesser toes with associated dorsal and interdigital lesions and even predisposition to secondary inversion sprain may occur due to hallux rigidus. Reid states that as available dorsiflexion of the first MTPJ is decreased below that needed for normal walking or athletic activities, the gait is altered and symptoms increase (7). The big toe may even become fixed in slight plantarflexion. Generally, the condition is characterized by a progressive loss of motion, particularly in dorsiflexion, exostosis formation, and pain (7) although with increasing stiffness in the big toe pain may decrease in the first MTPJ but increase secondarily in other areas of the foot (4).

Numerous authors have suggested a variety of etiologies as causative in hallux rigidus: a long narrow foot, too short footwear, a long (or too short) hallux, a tight medial band of the plantar fascia, a dorsiflexed first ray (4), pes planus or forefoot hyperpronation (6). But, the most common suggestion is trauma, sudden (such as dropping something on the joint or a violent soccer kick) or repetitive, particularly secondary to hyperextension of the joint as in American football or rugby (1,2,7-9). Although hyperextension (hyperdorsiflexion) has been long believed to be the cause of this disorder (10) this (hyperdorsiflexion instability) appears to be difficult to elicit on examination. To these reputed causative factors could be listed loss of 1st metatarsophalangeal joint play and end feel spring and the aggravating aspects of secondary joint dysfunction (subluxation complex due to antalgic gait) throughout other foot and ankle joints.

Hallux rigidus is usually categorized into three grades by x-ray findings:

Grade 1: Mild to moderate osteophyte formation with well preserved joint space.

Figure 1: Grade 2 Hallux Rigidus

Grade 2: Moderate osteophyte formation with joint space narrowing and subchondral sclerosis (Figure 1).

Grade 3: Marked osteophyte formation and loss of visible joint space with or without subchondral cyst formation (11).

Diagnosis of Hallux Limitus based on a literature review is made if at least 4 of the following 7 signs or symptoms are present.

1. Pain at the first metatarsophalangeal joint—particularly chronic pain.
2. Stiffness (loss of ROM), particularly in dorsiflexion of the 1st MTPJ.
3. Possible palpable exostosis.
4. Possible x-ray findings as above.
5. Positive axial grind test = pain on compression of the 1st MTPJ with small circumferential movement (a possible sign of articular cartilage damage) (2).
6. Occasional synovitis: tender, hot, and swollen joint.
7. Chiropractic/ motion palpation findings: loss of joint play or end feel spring (particularly in dorsiflexion).

In this review of literature no randomized placebo controlled trials of conservative treatments such as shoe modifications, padding, orthoses, physical therapy modalities, exercise, or manipulative care were found. Mobilization and/or manipulation has been advocated for a stiff painful big toe by chiropractors, osteopaths, physical therapists, podiatrists and orthopaedists (2,4,7,10, 12) yet no clinical studies have been published.

Hiss believed, and previously warned, that a thrust at the end range of dorsiflexion (into dorsiflexion) may be very irritating—yet it is dorsiflexion range of motion that is the primary motion lost and that must be regained for symptom and functional relief (10). Brantingham has developed a protective hallux rigidus adjustment and believes that when this is combined with other appropriate adjustments and mobilizations this has a much greater chance of, with markedly fewer side effects, treating grade 1 and some grade 2 hallux rigidus disorders. Brantingham also believes that, instituted early, these adjustments may stop or retard further development of hallux rigidus (particularly grade 1).

Surgery includes cheilectomy (removal of exostosis), osteotomies to dorsiflex the hallux or plantarflex the first metatarsal; arthrotomy with synovectomy and debridement; implant arthroplasty (2); the Keller procedure (resection arthroplasty), which removes the base of the proximal phalanx and produces a flail or floppy

joint (8); arthrodesis (fusion) in which the joint is permanently set in slight dorsiflexion is particularly chosen especially in younger athletes (7).

Surgical gains in range of motion vary from a reported 10 to 38° dorsiflexion with varying but lesser degrees of additional plantarflexion (2,3,13). Surgery is expensive, dangerous, with many complications, and often followed by a long period of expensive physical therapy. Surgery has no supportive randomized placebo controlled studies and often no follow-up blind evaluation, with a typical failure rate for grade 1 of 15% and 37% for grade 3; nevertheless these studies report satisfactory results in 60 up to 90% of patients (3,7,13).

CASE REPORT

A 36-year-old male professional tennis player and coach presented to one of the authors (JB) with a painful and stiff left big toe. The condition came on gradually in January of 1994 and he could not remember a single traumatic incident. Despite the pain, he continued teaching and playing tennis, running, and exercising. About 6 months later, the pain under his big toe became so bad that walking was a problem and in addition he could not push in the clutch of his car to shift gears. He began to limp and he felt that the limp (his antalgic gait) caused pain/discomfort to develop in his left knee.

He estimated, that on a scale of 0 being no pain and 10 being the worst pain, that the pain in his big toe was a "10" at that time.

At this point he went to an orthopedic surgeon, who took foot x-rays and told him that the spur on top of his big toe was causing the pain. A magnetic resonance imaging was done and the patient was told by the orthopedic surgeon that about 80% of his extensor tendon had been rubbed away.

Surgery was then performed with debridement and the tendon repaired. After remaining in a below-the-knee cast for 6 weeks, he began physical therapy. At that time, he estimated that his toe pain was about a "7" and he was worried that he would not be able to play.

The physical therapist also had him use elastic band exercises for his foot (but not for the big toe alone), a wobble board, and stretched his toe mildly into many different directions. This seemed to give him very little relief, although a toe separator, given to him after the physical therapy by the orthopedist, helped considerably (which possibly kept the 1st and 2nd metatarsal heads, and their exostoses, from rubbing against each other).

Disappointed with the progress up to that point, he consulted his first chiropractor in the United States in September of 1994, who treated him daily for two weeks with mobilizations and manipulations of the big toe and foot. At the end of his treatment he estimated that his level of pain was a "3." The treatment especially helped the overall function of the big toe, particularly the ability to actively plantarflex at toe off with less pain. After this, the pain remained markedly reduced ("3") for a number of years.

After about 4 years, the painful stiffness in his big toe began to recur around October and November 1999 and he estimated the level of pain was back up to a "6" by the time he consulted a different orthopedist. This orthopedist prescribed a NSAID (non-steroidal anti-inflammatory) which took the pain down to a "4;" the doctor instructed him to have his shoes "punched out" at a shoe store. The patient had a hole, to allow less pressure against the newly developed exostosis, made in all his shoes for tennis or any other activity.

It was about 8 months later that the patient, a professional tennis player, came to London, England, to view the Wimbledon tennis matches. While here, he consulted one of the authors (JB) for his big toe stiffness and pain, which was causing him a great deal of suffering during and after teaching and playing tennis.

At this time the big toe pain had increased to a "6" but sometimes, after taking the NSAID, it would decrease to a "4."

Observation demonstrated visible exostosis over his left first metatarsophalangeal joint (IMTP) (Figures 2–5).

Although no x-rays were available, it is reasonable to consider that this is a grade 2 hallux limitus. Feiss line evaluation demonstrates a grade 1 flatfoot in the medial

Figure 2: Visible exostosis at first MP joint

Figure 3: Additional view of visible exostosis at first MP joint

Figure 4: Additional view of visible exostosis at first MP joint

Figure 5: Additional view of visible exostosis at first MP joint

longitudinal arch. Some very mild hallux abducto valgus formation is apparent. Dorsiflexion ROM in the affected left toe was about 30° but about 65° in the opposite normal foot (Figure 6 and 7).

From a chiropractic perspective the left big toe lacked end feel dorsiflexion spring. Axial elongation joint play appeared nearly non-existent. Plantarflexion ROM and plantarflexion end feel spring of the first ray also appeared restricted.

Figure 6: Decrease dorsiflexion in the left great toe

Figure 7: Normal dorsiflexion motion in right toe

Other joint dysfunction (“subluxation complex”) noted in the left foot and ankle included restricted intermetatarsal shear between metatarsals 2 to 5; loss of axial elongation of the 2 to 5 toes; loss of dorsiflexion at the 2–5th metatarsals; loss of dorsiflexion and axial elongation of the ankle; loss of circumduction of the forefoot; loss of subtalar eversion (valgus) end feel.

The patient received 4 treatments over 2 weeks. The big toe adjustments included, on the first treatment, axial elongation (grade 4 mobilization) of the 1st MTP joint with a slow oscillation about 10–15 times (Figure 8).

On treatments 2–4 the grade 4 mobilization was continued but the Brantingham technique was also applied. The Brantingham technique is a modification of Schultz’s technique (14). The modifications are: *the big toe is tractioned firmly in axial elongation and mildly plantarflexed (to hold the exostosis / roughened joint surface apart). At this point a shallow HVLA impulse thrust is repeated about 3 to 5 times. No attempt is made to cavitate the joint (if this happens it is OK but is not necessary). An effort is made not to force any end feel dorsiflexion (to prevent jamming the exostosis and irritating the joint). The patient is supine and enough traction*

Figure 8: Axial elongation of first MP joint

is applied to slightly lift the involved foot off the table. This first adjustment is followed by icing the big toe. If after a few treatments there is no irritation of the joint, icing is not necessary (Figure 9).

Other adjustments were given for the foot and ankle as indicated, including mortice separation, subtalar eversion thrust, plantarflexion thrust of the first ray, fore-foot figure of 8, metatarsophalangeal dorsiflexion thrust, axial elongation of digits 2–5. These adjustments may also be crucial in gaining relief and increased function for the involved foot (10).

After 4 treatments, the patient reported that his level of pain was a “1.” The patient stated that 1) he felt markedly less pain in his big toe on use of his foot and big toe, 2) an increase in range of motion at toe off, and 3) an increase in strength in the big toe on plantarflexion at toe off.

Wimbledon was now over so he flew home to the United States with instructions to continue *gentle* dorsiflexion stretch 3 to 5×/day (no hard stretch with a “jamming” feel was allowed), toe range of motion exercises (active abduction, adduction, extension and flex-

Figure 9: Adjustive technique for first MP joint

ion) and cursive writing with the foot for maintaining range of motion of the foot and ankle. He was instructed in toe strengthening, which includes bilateral weightbearing plantarflexion (concentric strengthening of the toe flexors) with a small roll under the sulcus of the toes (a rolled washcloth) which includes slowly lowering the plantarflexed foot to the ground (eccentric strengthening). Exercise were to be done 2 to 3 times per day with 2 sets of 5 repetitions and were to be carefully increased or decreased if necessary. To primarily strengthen the plantarflexors of the big toe this same previous bilateral exercise was repeated, but after plantarflexion, the lateral side of the foot was to be lifted or everted off the ground (15).

The patient was warned to be particularly careful with this last exercise and to decrease repetitions if aggravated. In fact if exacerbated by any of the exercise the patient was to stop, rest until the aggravation was gone, and then begin again but with fewer repetitions.

The patient returned to the United States and was then contacted/followed by e-mail with the visual analogue scale (“0” being no pain and “10” being pain as bad as it gets = the worst pain) over approximately 6 months and then contacted one more time at about 10 months.

After the last treatment and when he got home to the US he felt well enough that he markedly increased his playing time (as opposed to teaching) on the tennis court and began to report each month a slight increase in pain as a result. Even with this increase in pain he frequently felt that he was markedly improved. He was contacted monthly from August through January 2001, at which time his pain level had slowly increased up to between 2 and 3 on the scale. Three months later (reported March 27, 2001) he was contacted one more time and reported “0” on the visual analogue scale (Figure 10), increase ROM, and increase plantarflexion strength in the big toe. The only additional change he had made in that time was to “punch out” all his shoes (make a slit in the shoe over the exostosis).

Figure 10 demonstrates the course of this particular hallux rigidus case with varying treatment approaches over a 7-year period. To follow the effect of chiropractic care delivered by the author (JB) the patient had to estimate what the pain would have been prior to commencement of the treatment.

DISCUSSION

Other treatments that may be of value in the management of hallux rigidus alone or helpful in conjunction with manipulative techniques are:

- 1 June – August 1994
Surgery (1st orthopaedist) and pain scores decrease from 10 - 7
- 2 August – September 1994
Physiotherapy and pain scores remain at 7
- 3 September 1994
Chiropractic (1st chiropractor) and pain scores decrease from 7 – 3.
- 4 Pain score of 3 remains for 4 years
- 5 October 1999
Pain scores increase to 6
- 6 December 1999
NSAIDs (2nd orthopaedist) prescribed and pain scores decrease to 4 and remain at this level for 6 months.
- 7 July 2000
Chiropractic (2nd chiropractor - JB) and pain scores decrease to 1
- 8 August - October 2000
Pain scores increase slightly to 2 and remain thus for 3 months (with increased tennis)
- 9 November 2000 – January 2001
Pain scores increase slightly to 2.5 and remain thus for 3 months
- 10 Before dropping and at March 2001 a pain score of 0 was recorded

Figure 10: Pain scores over time of care

1. An orthosis or arch pad (for example, of orthopaedic felt). Both increase plantarflexion of the first ray that is believed to “unlock” and increase dorsiflexion of the big toe (although the theory that a “dorsiflexed” first ray is the primary cause of hallux rigidus is not supported by some current research (6). One must be careful though that there is room for the exostosis or there may be aggravation.
2. A “rocker bottom” shoe that allows for an artificially “increased” dorsiflexion by it’s shape (now often built into sports shoes).
3. A metatarsal pad just proximal or under the metatarsal head.
4. A thickened sole or metal splint, both acting as splints (decrease dorsiflexion at the 1st metatarsophalangeal joint).

5. "Punching out" or slitting or stretching the shoe where the exostosis is found; or protective, circular orthopedic felt around the exostosis (with room in the toe box).
6. A foam or rubber toe separator if there is a great deal of exostosis.

If manipulative techniques are effective these other methods may not be necessary. Could early treatment of a grade 1 hallux rigidus decrease or stop further degenerative development and or symptoms? This is a possibility, but the efficacy and effectiveness of manipulative treatment (as all other treatments except surgery) are unknown at this time. At what point should manipulative treatment be instituted? On the face of it, early treatment would seem to be indicated but this is speculative.

Clinicians should be aware there may be possible reactions to mobilization or manipulation and consider application of ice when cryotherapy may be used prophylactically after the first few treatments or as necessary to decrease pain and inflammation. There is probably a greater possibility of aggravating a grade 2 (particularly an advanced grade 2) or a grade 3 hallux rigidus than a grade 1 disorder. It may be beneficial to use lower grades of axial elongation mobilization or even no mobilization at all to advanced grades 2 or 3 hallux rigidus. Even with a grade 3 hallux rigidus Hiss suggests that manipulation and mobilization of other foot and ankle joints, without treatment to the first MTPJ, is of real benefit to these patients. Other conservative treatments (as outlined above) can also be utilized (10). Certainly if two or more treatments increase pain, then manipulative therapy to the first MTPJ should be stopped. In some cases only surgery may give the patient relief and consultation and referral to an orthopedist is then required.

CONCLUSION

We believe it is a reasonable possibility that mobilization and the special "protective" manipulative technique applied to this patient's 1st MTPJ (along with general foot and ankle mobilization and manipulation) markedly reduced the pain of this patient's hallux rigidus.

But other factors such as placebo response, stretching, strengthening, "punching out his shoes," a desire to please the author must also be considered.

It is time to run a randomized controlled trial using valid and reliable subjective and objective measures, against placebo, to determine the efficacy of manipulation and mobilization in the treatment of hallux rigidus. Such a study might use selected dynamic pressure measurements (pedeography) for an objective measurement (16) as well as range of motion. Subjective measures may include common pain rating scales or additionally utilise the "hallux metatarsophalangeal-interphalangeal scale" by Kitaoka et al., as a specific subjective measure (17).

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