

## HALLUX VALGUS AND RIGIDUS TREATED BY ARTHRODESIS OF THE METATARSO-PHALANGEAL JOINT

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The treatment of hallux valgus and hallux rigidus cannot be looked upon as satisfactory. Although the operations in use sometimes relieve pain in the metatarso-phalangeal joint of the great toe and improve the appearance of the foot, far too many patients are not so relieved or continue to have pain at other of the metatarso-phalangeal joints, and there are few who do not remain to some extent disabled. Experience forces one to conclude that these operations are unsound in principle. In recent years I have preferred an operation which makes the metatarso-phalangeal joint of the great toe rigid in a position of slight dorsiflexion and abduction. This operation, which is based on the principle of preserving the strength and function of the great toe, has been so much more satisfactory than other operations that it is thought justifiable to advocate its general use.

### Aetiology

A rational operative treatment of either hallux valgus or rigidus based on what is known of their causation does not seem to be practicable. The primary cause of hallux valgus, and perhaps also of hallux rigidus, is evidently congenital anomaly of the form of the metatarsus. X-ray examination shows that in those feet without hallux valgus the metatarsals lie nearly parallel, their heads forming a slight curve convex distally, with the head of the second as the most distal point on the curve. In feet with hallux valgus, x-ray examination shows variations of this arrangement in relative length and in spreading of the metatarsals; corresponding with this, splaying of the forefoot is seen on physical examination. These anomalies of the metatarsus may often be symmetrical in any pair of feet. Associated with them may be other congenital anomalies such as partial webbing, flexion contracture, clawing, lateral deviation or other deformities of the toes, and poor muscular development. In particular, in feet with hallux valgus the first metatarsal is more or less adducted so that it diverges from the second metatarsal. This metatarsal is also often shorter and thicker than the others, and it may be partly rotated on its long axis. This divergence of the first metatarsal is evidently the underlying cause of hallux valgus, predisposing to outward deflection of the great toe from pressure of the shoe and from pull of the flexor and extensor tendons across the angulated joint, once deflection has begun.

Authorities differ regarding the explanation of this divergence of the first metatarsal. Morton (1935) maintains that it is due to delayed evolution from a pre-human ape-like state of the foot, in which the great toe with its metatarsal was adducted and separated from the rest of the forefoot as the thumb is in the hand. Wood Jones (1949) holds that it is due to a fault in ontogeny whereby the primitive radiating pattern of the metatarsals and digits more or less persists. However, it is not the primary cause of hallux valgus which is responsible for the symptoms in civilized races, but rather the secondary effects: the deflection of the toe, impairing its function; the exostosis on the head of the metatarsal and the overlying bursa, liable to inflammation, arising from friction and pressure from the shoe; osteoarthritis of the metatarso-phalangeal joint; and abnormal strain on the other joints of the forefoot because

the patient avoids taking weight on the great toe or is unable to do so in its displaced position.

It is less certain that hallux rigidus is primarily due to congenital anomaly of the metatarsus. A large-scale survey would be needed to determine this. However, it is notable that variation of the relative length of the metatarsals (the "metatarsal formula") can often be seen in cases of hallux rigidus. Hallux rigidus is a state of osteoarthritis of the metatarso-phalangeal joint of the great toe. Although the cause of osteoarthritis is uncertain, it is clear that it may occur when articular surfaces are repeatedly jarred, whether by an external influence or from malformation of a joint. Anomalies of the metatarsals, such as abnormal length of the first metatarsal, may predispose to repeated injury to the metatarso-phalangeal joint of the great toe, especially when shoes are worn. The symptoms of hallux rigidus arise from partial limitation of movement in the joint imposed by osteoarthritis, which causes pain from capsular strain and inability to rise on to the great toe in walking.

### Operations in Use

Of the operations which have long been in vogue for hallux valgus, only one (the Lapidus) attempts to deal rationally with the primary disorder, the others seeking to palliate the secondary effects. In the Lapidus operation an attempt is made by osteotomy of the proximal end of the shaft to correct the divergence of the first metatarsal and thereby to bring the toe straight. In practice it is found that the metatarsal cannot be properly aligned, and it is left as short as, or shorter than, before; nor are the associated other anomalies of the forefoot or the secondary effects at the metatarso-phalangeal joint of the hallux dealt with. Thus the operation is inadequate. Nevertheless, in adolescents, in whom secondary effects may not have developed and operation on the metatarso-phalangeal joint is in any case contraindicated because growth has not ceased, the operation is warranted, provided that there are no other anomalies of the forefoot which would make it not worth while.

There are serious objections to the other common operations for hallux valgus, which are also done for hallux rigidus. Simple removal of an exostosis leaves the great toe and its joint as before, though it is justifiable in adolescents and young adults with hallux valgus if deformity and limitation of movement are only slight.

The Mayo and Keller operations, though they correct deformity (apparently but not actually) and may increase the range of movement at the metatarso-phalangeal joint, gravely weaken this joint and either impair the usefulness of the hallux or at best do not improve it. Further, the Mayo operation, by excising the head of the first metatarsal, removes one of the main points of weight-bearing of the foot and thus weakens the whole metatarsus. The Keller operation, in which the base of the proximal phalanx is excised instead of the metatarsal head, leaves a shortened and much weakened great toe. Indeed, by both of these operations the great toe loses a large part of its function as a lever controlled by the flexor and extensor muscles, which is so important for the strength and use of the whole of the foot in walking. Thus after these operations patients cannot, in walking, make the normal final thrust of movement by rising on to the great toe, but tend to divert their weight towards the outer side of the foot. Abnormal strain is thereby thrown on to the other metatarso-phalangeal joints, especially the second or third, and pain in these joints and other effects such as oedema of the forefoot may follow. Exercises to strengthen the muscles of the foot and surgical shoes to provide support may lessen these effects, but in many cases not sufficiently. It is little consolation then to the patient to have a straightened and more mobile great toe if she has pain at another site and is still disabled.

It follows that any operation for hallux valgus or rigidus should preserve the strength and usefulness of the great

toe, even though it is not practicable at the same time to correct the primary cause of the disorder of the first metatarso-phalangeal joint. The operation of arthrodesis in this joint in a position of slight dorsiflexion and abduction does so preserve the function of the great toe, even though movement at the metatarso-phalangeal joint is abolished. The patient can take full weight and rise on the toe in walking and thus avoid putting abnormal strain on to other parts of the foot. Girdlestone's operation of "caphalangectomy," in which the distal two-thirds of the proximal phalanx of the hallux is excised and then arthrodesis made between the remaining base of the proximal phalanx and the head of the metatarsal, does not observe this principle as it leaves a much shortened toe which cannot take weight.

#### Technique of Operation of Arthrodesis

Arthrodesis may be done in the following way. A longitudinal incision is made, after a tourniquet has been applied to the limb, on the antero-medial aspect of the first metatarso-phalangeal joint extending over the whole length of the metatarsal and the proximal phalanx. The skin and subcutaneous tissues are raised on the inner side of the wound, clearing the exostosis and bursa. The capsule of the joint and the periosteum of the metatarsal and phalanx are incised in the line of the wound and raised medially and laterally so that the proximal two-thirds of the phalanx and the distal third and head of the metatarsal are cleared of soft tissues, while the adjacent tendons are preserved. Any exostosis on either the phalanx or the metatarsal is excised. The metatarsal head is denuded of articular cartilage and eburnated bone until a rounded convex surface of cancellous bone is exposed. The base of the phalanx is similarly treated, making a concave surface. The sesamoids, if enlarged by osteoarthritis, are removed by dissection. The rough surfaces of the phalanx and metatarsal are then apposed and fixed in a position of 30 degrees of dorsiflexion and 15 degrees of abduction of the toes. For this fixation a vitallium or stainless-steel screw may be inserted obliquely from the inner side of the metatarsal to the outer side of the phalanx, passing through the cortex of each bone, along the line of a hole made with a power-driven drill. Alternatively, stainless-steel wire or staples may be used

for fixation, but are more trouble to remove later. The capsular and periosteal layer is sutured; the tendon of extensor hallucis longus is drawn into correct alignment but injury to its sheath is avoided. The skin wound is closed. If there is deformity of the other toes tenotomy of the extensor tendons, interphalangeal arthrodesis, or other appropriate operation may be done at the same time. No external splintage is needed immediately.

Two weeks later, when the wound has healed, a below-knee plaster-of-Paris casing extending beneath the toes and with an iron or rubber heel is applied to allow the patient to walk and to leave hospital. The plaster casing is retained for six weeks, when fusion of the joint will have occurred. The fixation screw may be removed when x-ray examination shows complete fusion, through a  $\frac{1}{2}$ -in. (1.3-cm.) incision over the screw-head. After the plaster is discarded a strong leather-soled and low-heeled shoe without a toe-cap should be worn, and preferably should be specially made. A transverse metatarsal bar should be added to this to provide a fulcrum under the heads of the metatarsals. This is necessary as an aid to walking, for the angle of 30 degrees of dorsiflexion at which the great toe is fixed, though the maximum to allow a shoe to be worn, falls short of the degree needed for rising well on to the toe in walking. The fulcrum of the metatarsal bar compensates for this.

It must be emphasized that if the metatarso-phalangeal joint is fixed at less than 30 degrees of dorsiflexion (which corresponds to the normal resting position of the great toe when the foot is off the ground) painful strain is thrown on the interphalangeal joint and the patient cannot rise so easily on to the toe in walking. Weight may therefore be transferred partly towards the outer side of the foot, causing abnormal strain on other joints, so that the operation will have failed in its purpose.

The time of stay in hospital is no longer than for other operations and the disablement period is less, for the patient walks in plaster after two weeks, and when the plaster is removed can walk naturally, so that physiotherapy is hardly needed.

#### Results of Arthrodesis

This operation has now been done by myself or my assistants on 31 patients, 17 with bilateral states, making

TABLE I.—Details of Cases

Case No.	Age and Sex	Occupation	Hallux Rigidus or Valgus	Duration of Symptoms	Date of Operation	Result
1	53 M	Shop manager	H.R.	"Years"	24/10/46	Free of pain and disablement. Normal walk
2	54 F	Bar attendant	H.V.	" "	15/9/50	" " " " " " " " " " " "
3	28 F	Housewife	" "	" "	20/9/50	Some residual pain in hallux and foot and disablement
4	56 F	" "	H.V. (bilateral)	2 years	20/10/50	Free of pain and disablement in both feet. Normal walk
5	43 F	" "	H.V.	"Years"	20/10/50	Occasional ache in hallux and dorsum of foot. Still deviates weight to outer side of foot
6	40 F	Shop assistant	H.V. (bilateral)	20 years	11/11/50	Free of pain and disablement in both feet. Normal walk
7	61 F	Housewife	H.R. Rt. H.V. Lt.	"Years"	10/11/50	Free of pain in hallux. Still some ache in feet. No disablement. Normal walk
8	45 F	" "	H.R.	10 years	15/11/50	Free of pain and disablement. Normal walk
9	55 F	" "	H.V.	"Years"	17/11/50	" " " " " " " " " " " "
10	68 F	" "	" "	" "	6/12/50	Free of pain in hallux, but some ache in foot and ankle
11	56 F	Guest house	" "	" "	15/12/50	Free of pain and disablement. Normal walk
12	54 F	Seamstress	H.V. (bilateral)	20 years	20/12/50	Free of pain and disablement in both feet. Normal walk
13	53 F	Hotel assistant	" "	"Years"	3/1/51	" " " " " " " " " " " "
14	61 F	Housewife	" "	" "	5/1/51	Free of pain in hallux, but some aching in feet and remains disabled
15	42 F	" "	" "	" "	12/1/51	Free of pain in hallux, but some aching in feet and some disablement
16	42 F	" "	H.R. Rt. H.V. Lt.	10 years	13/1/51	Free of pain and disablement in both feet. Normal walk
17	59 F	" "	H.V. (bilateral)	1½ "	19/1/51	" " " " " " " " " " " "
18	53 F	" "	" "	6 "	2/2/51	" " " " " " " " " " " "
19	66 F	" "	H.R.	1 year	2/2/51	Still has pain in hallux and disablement
20	50 F	" "	H.R.	5 months	10/2/51	" " " " " " " " " " " "
21	47 F	" "	H.V. (bilateral)	4 years	14/3/51	Free of pain and disablement. Normal walk
22	42 F	" "	H.V.	10 "	23/3/51	Free of pain in hallux, but ankle aches. Tires easily
23	55 F	" "	H.V. (bilateral)	"Years"	23/3/51	Free of pain, but still has some disablement due to rheumatoid arthritis
24	29 F	Domestic	" "	15 years	4/4/51	Free of pain in hallux, but some pain in right ankle
25	55 M	Labourer	" "	30 "	11/4/51	Free of pain and disablement. Normal walk
26	50 F	Domestic	H.V.	"Years"	11/4/51	" " " " " " " " " " " "
27	52 F	" "	H.V. (bilateral)	4 years	23/5/51	" " " " " " " " " " " "
28	56 F	Housewife	H.V.	20 "	24/7/51	" " " " " " " " " " " "
29	62 F	Nurse	H.V. (bilateral)	30 "	4/8/51	Free of pain in hallux, but some in ankles
30	52 F	Housewife	H.V.	—	17/8/51	Free of pain in hallux, but still some aching in foot and disablement
31	49 F	" "	" "	"Months"	5/9/51	Free of pain in hallux, but persisting pain in osteoarthritic ankle

TABLE II

	Cases	Hallux Valgus	Hallux Rigidus
A. Free of pain and disablement in hallux and foot	28 (58%) (11 bilateral)	25	3
B. Free of pain in hallux, but some occasional or persistent pain elsewhere in foot or disablement	15 (31%) (5 bilateral)		
C. Not free of pain or disablement	5 (11%) (1 bilateral)		
Totals	48 (31 patients —17 bilateral)	41	7

41 cases of hallux valgus and 7 cases of hallux rigidus (Tables I and II). The number of cases of hallux rigidus is smaller because only severe cases were operated upon, most cases being relievable by non-operative means. One case was treated six years ago, and the patient, a man aged 53, has remained free of pain and disablement and is able to lead a life requiring much standing and walking. The other cases were done during the period September, 1950, to September, 1951. The period elapsing since operation in at least some of these cases is too short for a proper assessment of the value of the method, but the results to date seem to be worth recording.

As with other kinds of operation for hallux valgus or rigidus, the result is affected by the association of other states of the feet which may cause pain or disablement or prevent full recovery of function. Such associated states were present in most of the cases, consisting in splaying of the metatarsus, clawing or other deformity of other toes, onychogryposis, pes plano-valgus, dorsal bony prominences, luxation or stiffness of other metatarso-phalangeal joints, osteoarthritis of these joints or of the tarsal or ankle-joints, rheumatoid arthritis, or varicose veins. One case had had a previous Mayo operation. Nevertheless, of the 41 cases of hallux valgus, there is freedom from pain and disablement, and a normal walk, in 25. In 14 cases of hallux valgus no pain is now felt in the hallux (metatarso-phalangeal joint), but still some pain, occasional or persistent in walking, elsewhere in the foot, or some disablement; in two cases pain in the hallux and disablement persist. Of the seven cases of hallux rigidus, three are free from pain and disablement and walk normally; one still has some pain elsewhere in the foot; and three still complain of pain in the hallux and of disablement.

Thus of 48 cases, 28 (58%) may be deemed quite satisfactory. A further 15 (31%) may also be thought satisfactory, allowing for the presence in most cases of other causes of pain or disablement of the foot. Five cases (11%) are failures in that there has been no relief of pain in the hallux. Failure to relieve pain elsewhere in the foot or disablement has been attributable largely to associated states, such as clawing of the toes with stiffness of the metatarso-phalangeal joints, not being fully amenable to treatment carried out at the same time as that for the hallux valgus or rigidus. But failure to relieve pain in the hallux and in some cases elsewhere in the foot has been due to fixation of the metatarso-phalangeal joint during arthrodesis at an angle of less than 30 degrees of dorsiflexion, so that the patient on walking again has not been able to take weight properly and to rise on to the hallux.

### Summary

An operation of arthrodesis of the first metatarso-phalangeal joint for hallux valgus and rigidus is described and advocated for use in adults in preference to the other operations at present in vogue for these conditions.

It is considered that in any operation for hallux valgus or rigidus the need is to preserve the function of the

great toe, and that while arthrodesis of the metatarso-phalangeal joint as described observes this principle, other operations (removal of the exostosis, the Mayo, Keller, and Girdlestone) fail to do so and are therefore unsatisfactory.

[Since the above was submitted for publication a year ago 52 more cases have been treated by arthrodesis, making, in 64 patients, 100 cases in all (36 bilateral)—84 of hallux valgus and 16 of hallux rigidus. A survey of all cases treated up to six months ago has given a similar result to that in Table I for the first 48 cases, except that the proportion of cases of hallux rigidus relieved of pain is higher.]

### REFERENCES

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## THIOURACIL IN TOXIC GOITRE LATE RESULTS IN A PERSONAL SERIES

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Thiouracil and allied substances have been used in this unit since December, 1943, and a preliminary report was published in May, 1945 (Kennie, 1945). It was decided to make a close personal observation of a series of cases of thyrotoxicosis treated by this method for a period of at least five years. This work was undertaken by one of us (A. T. K.), but was interrupted and continued by the other (D. D.) up to the time of writing. The report which follows deals with the results of thiouracil treatment and the conclusions drawn from a personal series observed over a period of approximately seven years.

### Clinical Material

During the period under review 222 cases were accepted for treatment. All the patients referred to the unit as cases of toxic goitre and in whom the diagnosis was considered to be correct were treated by this method. In mild cases the differentiation between anxiety states and thyrotoxicosis is often difficult. Many cases of anxiety neurosis were referred from other sources as toxic goitre, but were rejected for thiouracil treatment at the clinic. Even so, 13 cases included in the series were later thought to be anxiety states. Eleven cases have been excluded because the follow-up period has been less than one year, which is regarded as too short for reliable assessment of the outcome of treatment. In a further 11 cases trace of the patient has been lost. There are thus left for study 187 cases. An assessment of initial severity was made on clinical grounds, the B.M.R. being found less reliable. The numbers in each group were as follows: severe 55, moderate 84, mild 48.

The series comprised 21 men and 166 women, a proportion of males to females of 1 to 8. Their ages ranged from 14 to 68 years. One hundred and eleven were treated entirely as out-patients and were seen at a special weekly clinic. The remaining 76 were in hospital at some stage in their illness. The early cases were all admitted, but, later, out-patient treatment was customary and patients were admitted