Acta orthop. scand. 45, 271–295, 1974

The London Hospital and the Enfield Group of Hospitals, London, England.

SURGERY FOR ADOLESCENT HALLUX VALGUS

B. HELAL, S. K. GUPTA & P. GOJASENI

Accepted 6.vi.73

Over 130 different operations have been described for adolescent hallux valgus. A representative selection is illustrated in the diagrams (Figure 6). Each operation is based on the inventor's concept of the relative importance of various aspects of the pathological anatomy of the deformity (Figure 1).

This bewildering variety of surgical procedures is described, each with its own advocate, so the choice of operation remains a problem. Although reviews of certain operative procedures are available (Simmonds & Menelaus 1960, Gibson & Piggott 1962, Wilson 1963, Waugh 1963, Carr & Boyd 1968, on the Mitchell operation) the operation chosen often depends on where the surgeon was trained.

Our aim was to present an objective assessment of the operations in current use, thus providing some guide as to the best procedure for the uncommitted surgeon (Figures 2, 3, 4).

A prospective review could have meant performing many unsatisfactory operations so we decided on a purely retrospective review. Unfortunately, adequate preoperative data were not always available from the records we collected, so we discarded all the cases with no preoperative X-rays.

Experienced, highly skilled, surgical technicians can often turn a "sow's ear" of an operation into a "silk purse" of a result; so we assessed not only the end results, but also factors including the technical difficulties and the morbidity of any given procedure.

We compared the more popular procedures. We sent a questionnaire to 450 orthopaedic surgeons in Britain, (Table 1); 370 replies reflected their interest in the problem. Many contained useful and interesting information and we are indebted to them all.

In Britain each year, over 2,000 adolescent patients are operated on for hallux valgus, a measure of the importance of the condition; 296 surgeons stated their choice of procedure (Table 2 A).

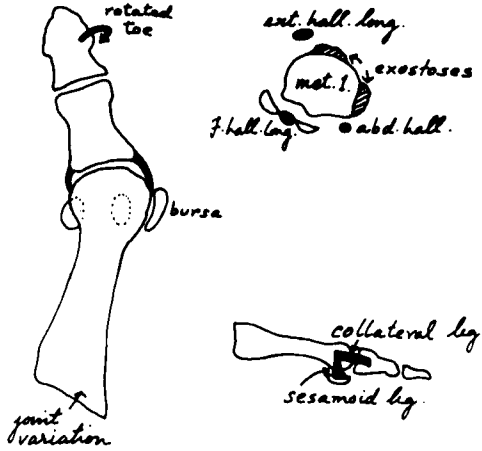


Figure 1. Pathological anatomy of hallux valgus.

Left: Some of the features seen in A.P. X-rays of the toe and first metatarsal.
Upper right: Coronal section of head of first metatarsal to show exostoses and displacement of tendons.
Lower right: Lateral view to show the ligamentous connection between the hallux and first metatarsal.

MATERIAL AND METHODS

We began our review in 1966. The procedures chosen for study were the two most popular representatives from each group of operations. Table 2 B shows the operations chosen and the length of follow-up. Figures 2–5 show some of the procedures described and some of the complications.

Particular note was taken of the weight-bearing function of the metatarsal arch as evidenced by metatarsalgia and of callosities under the lateral metatarsal heads. An imprint of the foot was taken when there was a normal unoperated side for comparison.

The patients' ability to wear a standard shoe in complete comfort was also noted.

A fresh antero-posterior X-ray was taken and observations made of:

(a) the distance between the first and fifth metatarsal heads measured from their external borders.
(b) the gap between the first and second metatarsal heads.
(c) the state of bony union where osteotomy had been performed.
(d) the degree of subluxation of the first metatarso-phalangeal joint.
(e) the presence of degenerative changes in the joint.
(f) the state of the epiphysis of the first metatarsal.
(g) the displacement of the sesamoids and their condition.
(h) the degree of rotation of the hallux and any deviation at the interphalangeal joint (Bonney & MacNab 1952).

Table 1. Questionnaire.

1. What operations do you do for adolescent hallux valgus?
2. Why did you select the particular procedure?
3. Have you encountered any disadvantages, difficulties or complications from your procedure?
4. What, on average, is the number of cases you operate on for this condition in a year?
5. What proportion of the cases that you see for adolescent hallux valgus come to surgery?

Table 2 A. Operations of choice produced by 296 surgeons in the British Isles.

	Operations	No. of surgeons
A. *Osteotomies*	Butler	4
a) of the proximal phalanx	Unnamed	12
b) of the first metatarsal	Simmonds	20
(i) basal	Golden	9
	Rocyn Jones	2
	Stamm	1
	Unnamed	10
(ii) shaft	Wilson	31
	Modified McBride	20
(iii) head and neck	Hohmann	18
	Mitchell	44
	Thomason–Mygind	8
	Gibson–Piggott	7
	Cholmeley	1
	Peabody	20
B. *Exostectomies* with soft tissue procedures	McBride	34
	Unnamed	10
C. *Fusions*		
a) of the first metatarso-phalangeal joint		17
b) of the first metatarsal epiphysis	Ellis	1
D. *Arthroplasties*	Keller	17
	Mayo	1
E. *Miscellaneous*	Girdlestone	2
	Joplin	7

Table 2 B. The review of operations for adolescent hallux valgus. (Reviewed in out-patients 1966–1968).

Operation	Number of feet	Age in years	Follow-up after operation in years			
			0–3	3–6	6–9	9–12
Simmonds	35	14–19	2	4	12	17
Golden	35	14–19	15	17	3	–
Modified McBride	35	14–19	–	8	17	10
Wilson	35	9–19	22	6	7	–
Peabody	35	12–17	14	17	4	–
Mitchell	35	10–18	8	13	14	–
Joplin	35	10–19	20	12	3	–
McBride	35	13–19	21	14	–	–

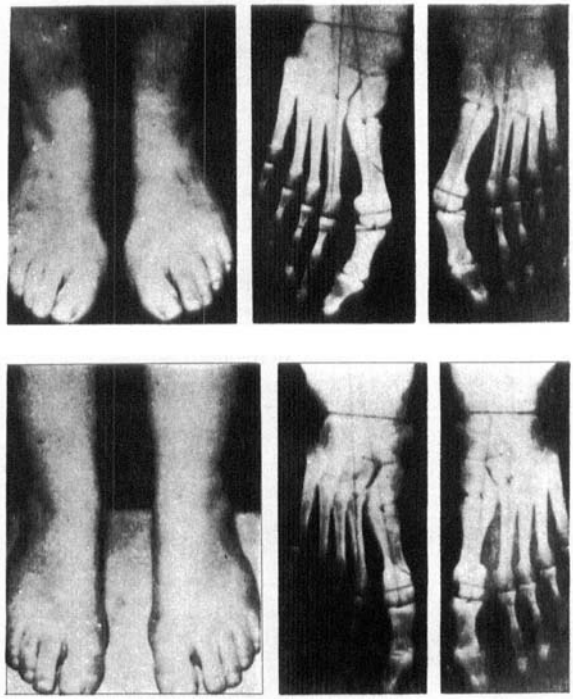


Figure 2 A. The correction of deformity by the Simmonds operation.

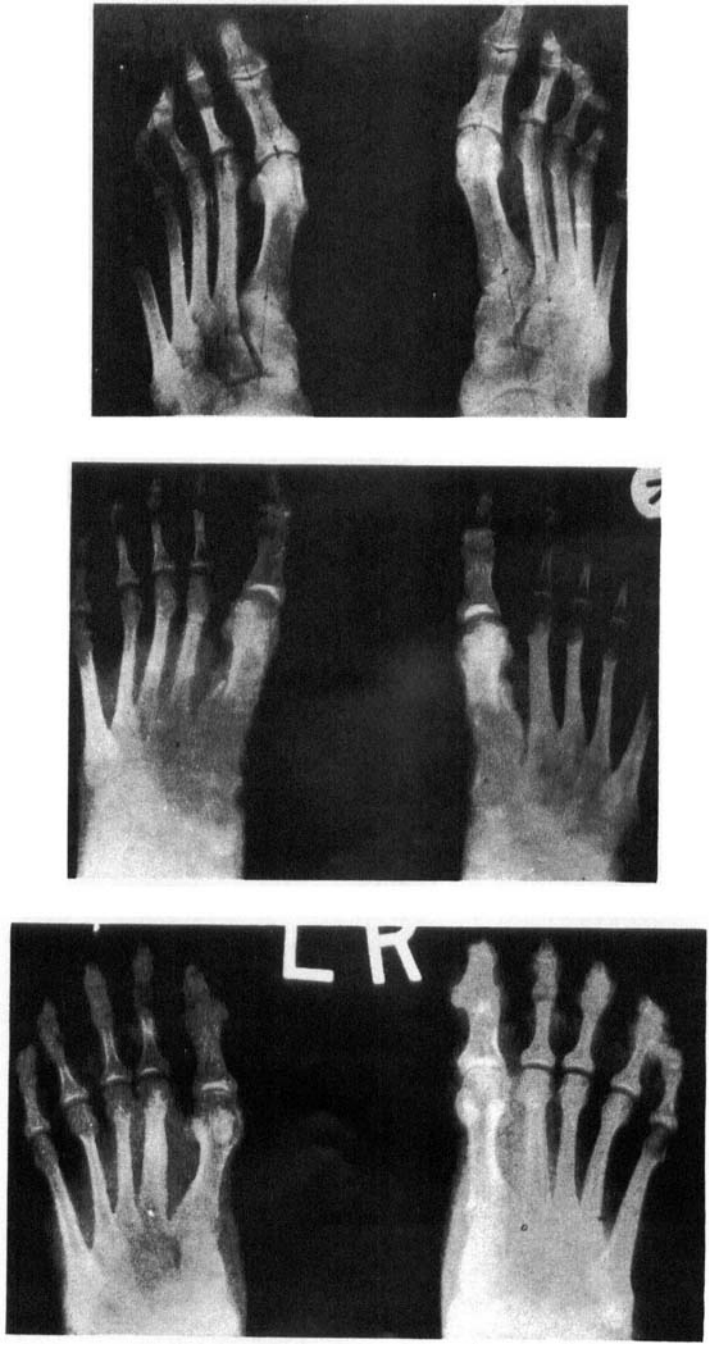


Figure 2 B. The correction of the valgus deformity by the Golden operation.

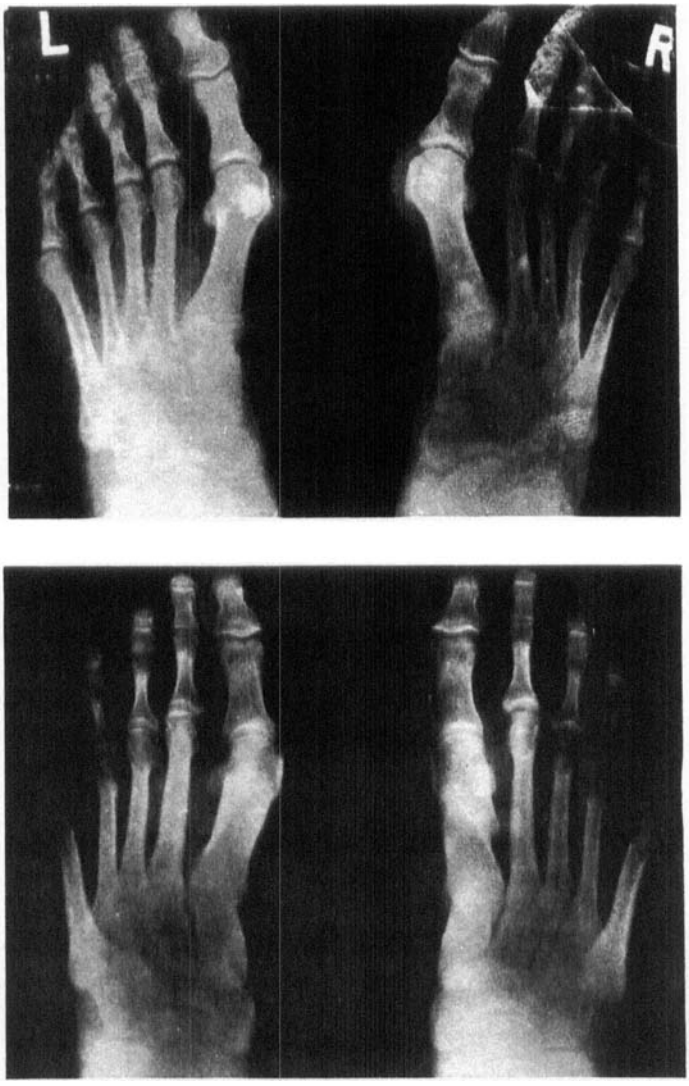


Figure 3 A. The correction of deformity following the Wilson operation of the right foot.

The patients' views regarding the results of the operation were recorded. The end result was assessed by us and classified as excellent, good or poor. The criteria employed are shown in Table 3.

Procedures discarded from this review

We collected small numbers of metatarso-phalangeal joint fusions, excision arthroplasties, osteotomies of the base of the proximal phalanx and epiphysiodeses

Figure 3 B. The over-correction of deformity by the modified McBride operation of the right foot.

Table 3. Criteria for classification of the results after operation. (after Bonney & McNab)

Results	Amount of hallux* valgus (in degrees)	Intermeta-tarsal§ angles (in degrees)	Range of movements of the first meta-tarsophalangeal joint	Symptoms	Function
Excellent	0–20	0–12	Full range		Full
Good	0–30	0–16	Some limitation of dorsiflexion or active plantarflexion	Occasional ache in the meta-tarsophalangeal joint after use. No bunion.	Satisfactory
Poor	>30	16	Marked limi-tation of movements or no movement	Frequent pain in the meta-tarsophalangeal joint or foot. Bunion present	Impaired

* Degrees of hallux valgus is the angle between the axes of the first metatarsal and the proximal phalanx.

§ Intermetatarsal angle is the angle between the axes of the first and second metatarsals.

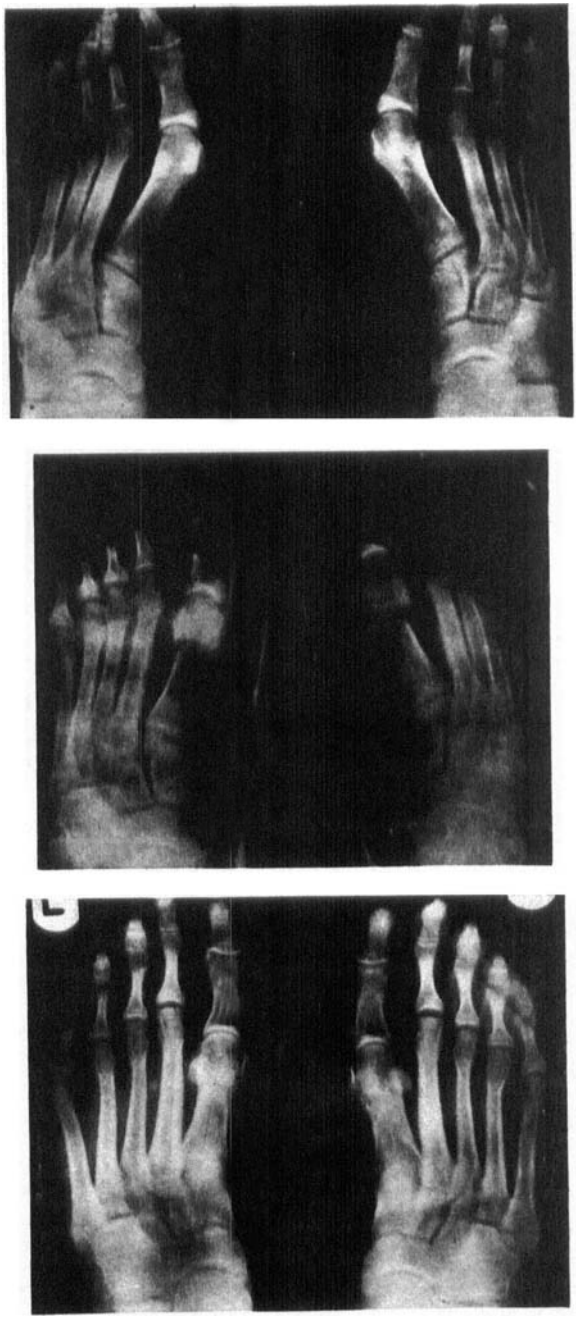


Figure 4 A. The correction of deformity in the immediate post-operative period and five years after the Peabody operation.

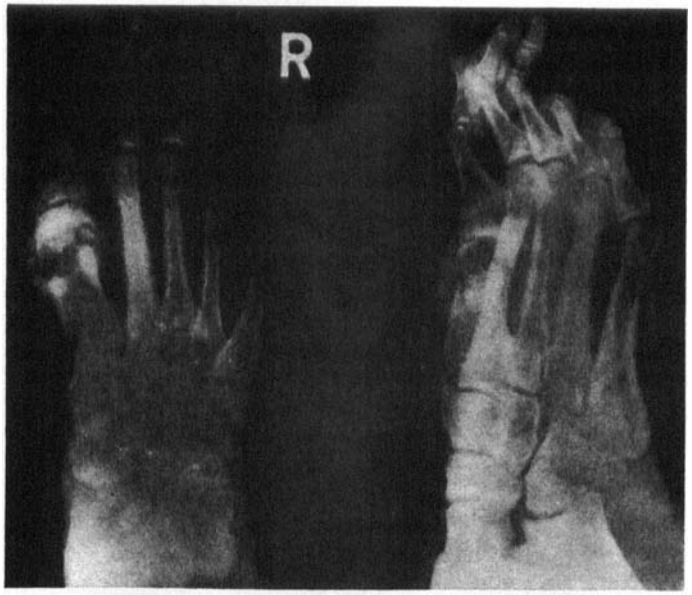


Figure 4 B. A case of non-union following the Peabody operation.

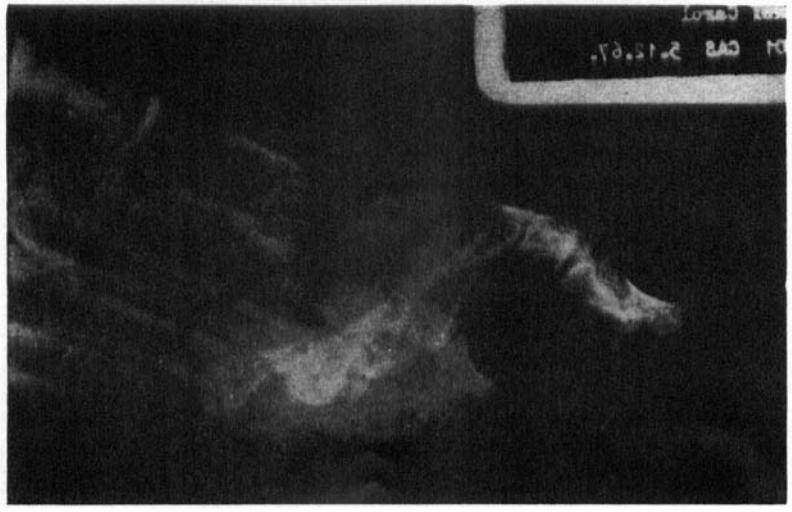


Figure 5 A. A case of dorsal tilling of the distal fragment following Wilson operation.

of the first metatarsal. We abandoned the search for further cases as the results were much poorer than the other procedures.

Epiphysiodesis of the base of the first metatarsal is a rational approach, but most cases present too late for the deformity to be influenced significantly by arresting

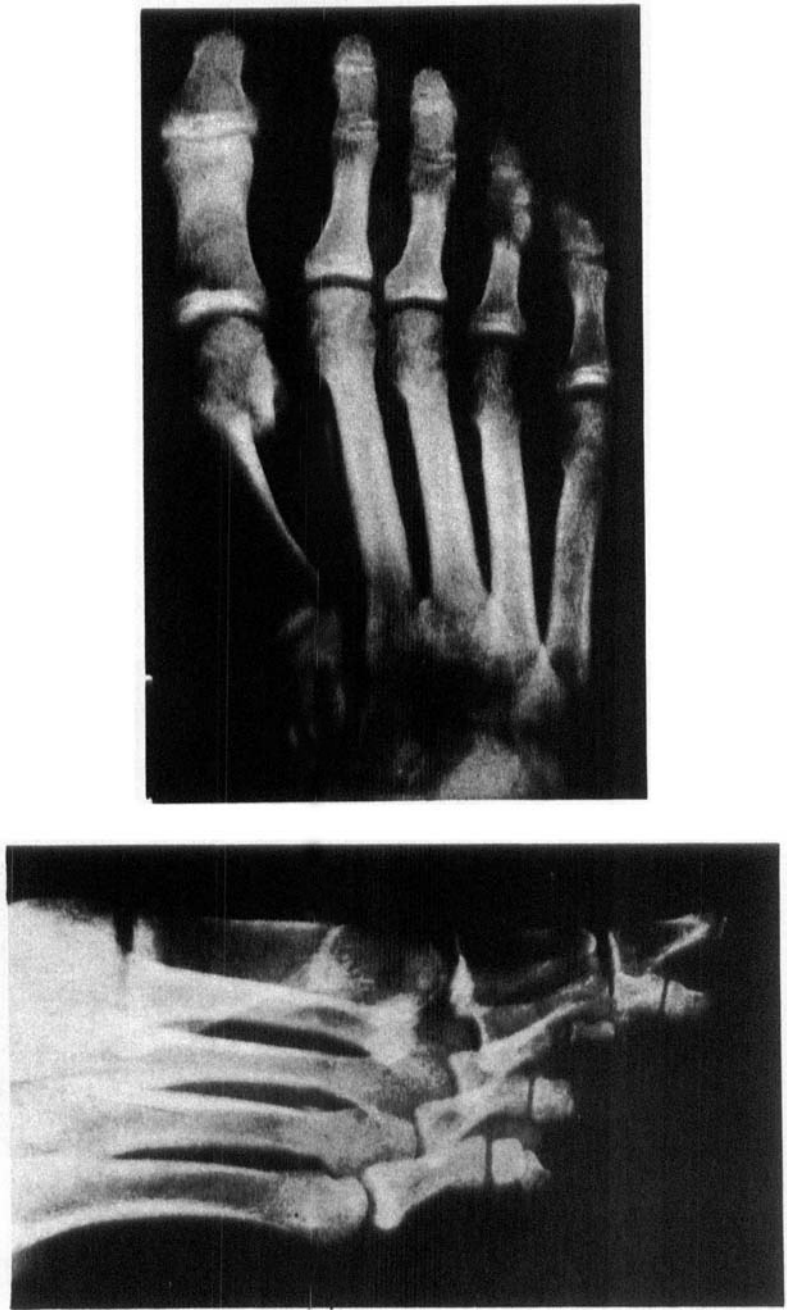
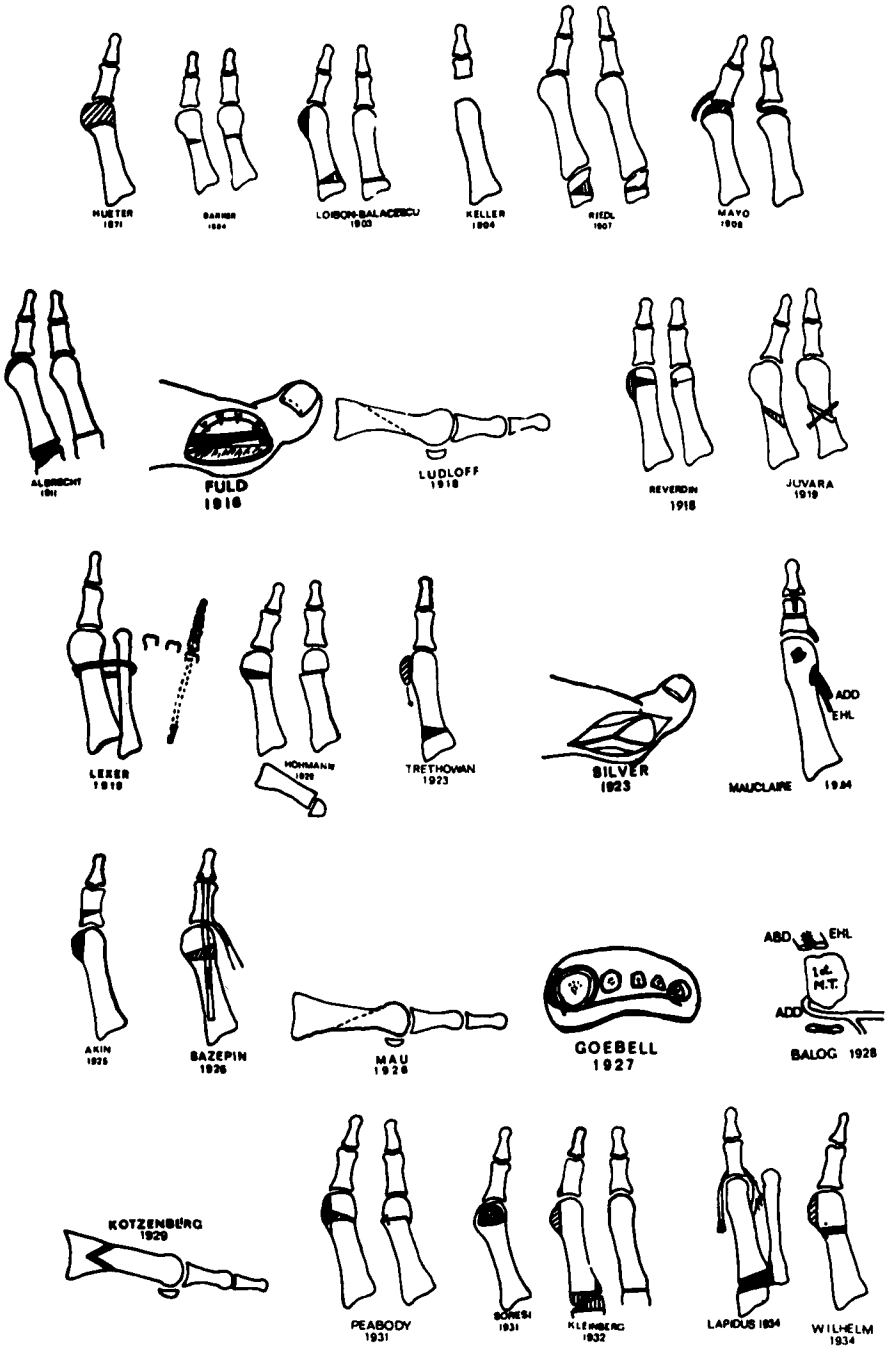
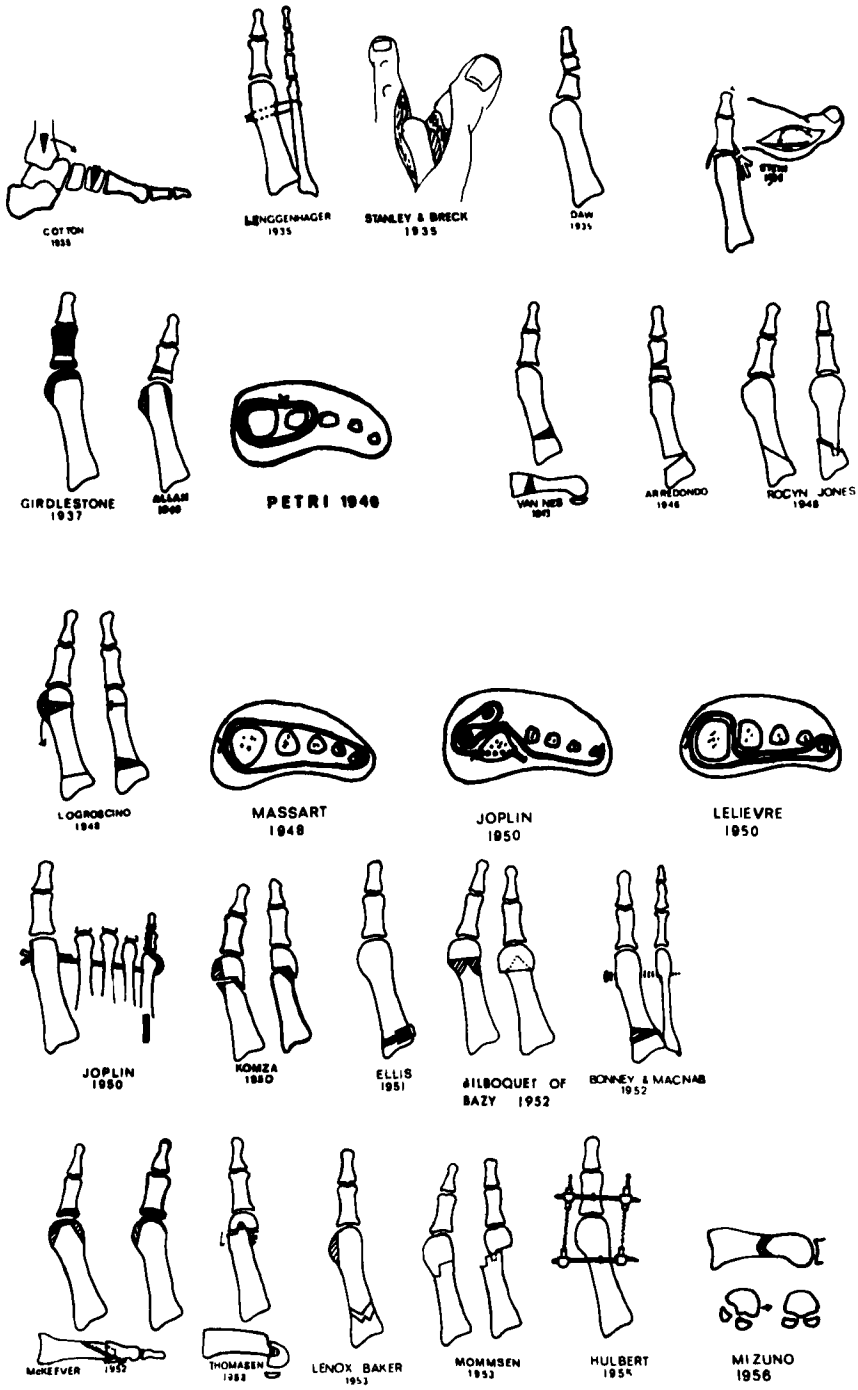


Figure 5 B. The double-oblique osteotomy of the metatarsal by modifying the Wilson operation.


HUETER
1871
LOISON-BALACESCU
1903
KELLER
1904
RIEDL
1907
MAYO
1908
ALBRECHT
1911
FULD
1918
LUDLOFF
1918
REVERDIN
1918
JUVARA
1919
LEXER
1919
HOHMANN
1920
TRETHOWAN
1923
SILVER
1923
ADD
EHL
MAUCLAIRE
1924
AKIN
1925
SAZEPIN
1926
MAU
1928
GOEBELL
1927
ABD
EHL
1st M.T.
ADD
BALOG 1928
KOTZENBERG
1929
PEABODY
1931
SONESI
1931
KLEINBERG
1932
LAPIDUS 1934
WILHELM
1934


COTTON
1938
LENGGENHAGER
1935
STANLEY & BRECK
1935
DAW
1935
GIRDLESTONE
1937
ALLAN
1940
PETRI 1940
VAN NES
1947
ARREDONDO
1946
ROCYN JONES
1948
LOGROSCINO
1948
MASSART
1948
JOPLIN
1950
LELIEVRE
1950
JOPLIN
1950
KOMZA
1950
ELLIS
1951
GILBOQUET OF
BAZY 1952
BONNEY & MACNAB
1952
McKEEVER 1952
THOMASEN
1952
LENOX BAKER
1953
MOMMSEN
1953
HULBERT
1955
MIZUNO
1956

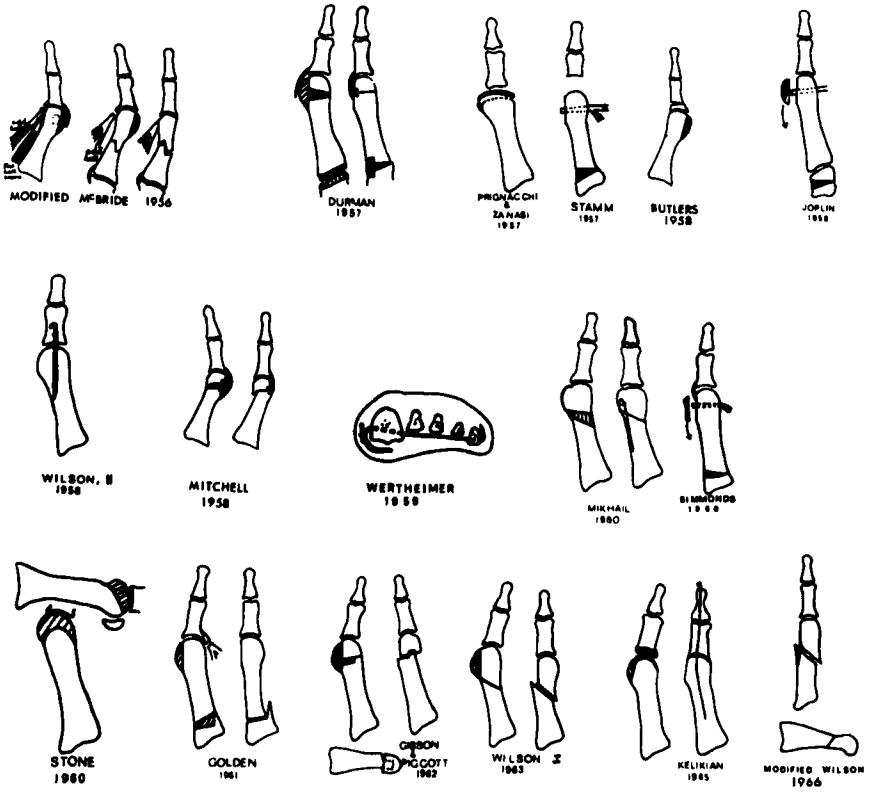


Figure 6. A selection of the operations described for adolescent hallux valgus.

further growth; secondary deformities have already occurred at the metatarso-phalangeal joint.

Out of 842 operation records, only 378 provided adequate pre-operative data. From these we selected 35 of each procedure as being suitable for comparison, as this was the largest number of Joplin and Golden procedures available. We therefore took the 35 cases with the longest follow-up from those procedures where larger numbers were available.

All patients within seventy miles of London were contacted and requested to attend for examination at the hospital where they had had their operations.

Method

A fresh history was taken, including pre- and post-operative symptoms; and compared with the pre-existing notes. Operative methods were recorded and any complications noted.

X-rays: Intermetatarsal angles were measured on the pre- and post-operative X-rays. The standard mean intermetatarsal angle is 8.9° in the normal adolescent foot and 13° in the morbid group, (Hardy & Clapham 1951) with a variation of

Table 4. Correction of metatarsus primus varus in degrees by osteotomy.

Intermetatarsal angle	0–2	2–4	4–6	6–8	8–10	10–12
Simmonds	–	2	5	6	19	3
Golden	1	7	9	4	14	–
Modified McBride	2	9	11	5	8	–
Wilson	–	–	1	14	16	4

It is interesting to note that those patients operated upon some years before closure of the epiphysis at the base of the first metatarsal, exhibited an average increase in the intermetatarsal angle of 3.5°. This compares well with the average correction of 9°. Correction of metatarsus varus is therefore well maintained.

0–17° and 4–27° respectively. When considering the modified McBride, Wilson, Peabody and Mitchell operations, the axis of the corrected distal segment of the first metatarsal was employed as the line of reference.

Other measurements included the angle of post-operative valgus and the length of the first and second metatarsals; Hardy & Clapham (1951) recorded the relative first metatarsal protrusion as 2 mm in the normal and 4 mm in the morbid group.

For functional assessment the range of dorsiflexion and plantar flexion was measured with a goniometer. Note was taken of the ability to squat, run and jump. The cases were then classified according to Bonney & MacNab's (1952) method.

We examined basal metatarsal osteotomies to determine whether, with time, there was any significant further drift of the metatarsal into varus. We found that over an average period of four years between the operation and cessation of growth, the degree of increase of varus as measured at the intermetatarsal angle was 0–6° with an average increase of 3.5°. This could be compared with the average correction of the varus by osteotomy of 9.5° (Table 4).

We would have liked to include Hohmann's procedure in our analysis but were unable to collect enough cases. From the few we investigated, it would seem that the results are about the same as those of the Mitchell operation, despite the fact that the Hohmann osteotomy is more unstable.

Analysis

92 per cent of the patients were female, aged from 9 to 19 years; in three quarters of the cases, the condition was bilateral.

160 surgeons answered part 5 of our questionnaire. Of these, 2 per cent operate on all adolescent valgus great toes, 5 per cent avoid operating and 65 per cent operate on about half the number they see. 28 per cent of the replies were ambiguous.

The number of patients seen by any one surgeon varies greatly in different areas, because most general practitioners know in advance that the surgeon is unlikely to recommend operation.

280 feet were included in the full analysis. Table 5 shows the various procedures, the length of follow-up and the residual degree of hallux valgus.

Table 5. Correction of hallux valgus and its maintenance.

Correction of hallux valgus and its maintenance	Angles in degrees	Number of feet operated upon							
		Simmonds	Golden	Modified McBride	Wilson	Peabody	Mitchell	Joplin	McBride
Pre-operative	0–10	–	–	–	–	–	–	–	–
	10–20	–	–	–	–	–	–	–	–
	20–30	8	9	8	7	7	10	9	11
	> 30	27	26	27	28	28	25	26	24
Immediate post-operative	varus 0–10	–	–	1	–	–	–	–	2
	valgus 0–10	13	8	13	10	1	5	12	16
	10–20	18	19	18	15	15	14	18	16
	20–30	4	8	3	10	17	16	5	1
	> 30	–	–	–	–	–	–	–	–
0–3 years follow-up	0–10	2	3	–	8	–	–	–	–
	10–20	–	9	–	10	6	6	3	6
	20–30	–	3	–	4	3	2	7	8
	> 30	–	–	–	–	5	–	10	2
3–6 years follow-up	0–10	1	5	3	1	–	2	–	3
	10–20	3	5	4	5	3	5	1	5
	20–30	–	3	1	–	7	6	5	4
	> 30	–	4	–	–	7	–	6	2
6–9 years follow-up	0–10	4	–	7	1	–	1	–	–
	10–20	6	2	8	6	1	6	–	–
	20–30	2	1	2	–	2	5	1	–
	> 30	–	–	–	–	1	2	2	–
9–12 years follow-up	0–10	6	–	4	–	–	–	–	–
	10–20	9	–	6	–	–	–	–	–
	20–30	2	–	–	–	–	–	–	–
	> 30	–	–	–	–	–	–	–	–

Inference – Corrections which depend on a soft tissue element are not well maintained and recurrences of deformity occur within three years of surgery.

DISCUSSION

Factors influencing the results—taking account of both objective and subjective findings we believe that the following factors significantly affect the results:

1. The technical difficulty of the procedure.

2. The amount of mobility in dorsiflexion at the first metatarso-phalangeal joint, for this is most important in squatting (the most severe test), tiptoeing and varying the height of a shoe heel. The mobility is affected by these factors:

(a) The degree of soft tissue dissection with its influence on the degree of post-operative fibrosis and so, on the suppleness of the soft tissues.

(b) Interference with the joint capsule and ligament.

(c) The relative length of bony to soft tissue structure influencing the soft tissue tension.

3. The width of the forefoot at the level of the metatarsal heads: Subjectively this was very much more important than the degree of valgus at the metatarso-phalangeal joint.

4. The ability of the first metatarsal head to take its due share of weight.

5. The stability of the procedure with regard to maintaining correction.

1. *The technical difficulty of the procedure*

Approximately half the procedures were performed by junior surgeons, usually of registrar status. The morbidity in the technically simple procedures was not significantly influenced by the experience of the surgeons. In the more technically difficult procedures the overall morbidity was higher and was disproportionately high when performed by less experienced surgeons.

2. *Amount of mobility*

The range of dorsiflexion at the first metatarso-phalangeal joint was very much more important than the range of flexion. It would seem that a significant degree of flexor power is important only to those engaged in athletic activities.

(a) *The extent of the soft tissue dissection:* In the immediate post-operative period, the more the soft tissue dissection, the greater was the discomfort (as determined by the analgesic requirements); there was also delay in wound healing, a higher incidence of superficial infection and a proportionate (often significant) loss of mobility with impaired function.

Table 6. The measurement of the relative first and second metatarsal protrusions.

Operations	+3 mm	+2 mm	+1 mm	0 mm	−1 mm	−2 mm	−3 mm	−4 mm	−5 mm	−6 mm
Simmonds	12	18	5							
Golden	2	7	8	10	5	2	1			
Modified McBride			14	13	8					
Wilson				1	4	13	7	6	3	1
Peabody				2	6	11	9	4	3	
Mitchell			1	3	15	14	2			
McBride			20	12	3					
Joplin				18	14	3				

(b) *Interference with the joint capsule and ligament:* Procedures in which the joint was opened or the capsule tightened produced more joint stiffness.

(c) *Procedures which increase the bone length:* These cause relative increase in soft tissue tension and so reduce joint mobility (Table 6, Figure 2 A). Although we were unable to demonstrate the fact in our patients, increased tension across a joint could, theoretically, cause or accelerate degenerative changes.

3. *The width of the forefoot*

Narrowing of the forefoot rather than a straight great toe was the most valued asset to the female after the absence of discomfort and the presence of mobility (Table 7).

Table 7. Narrowing of the forefoot after operation.

	0–4 mm	4–8 mm	8–12 mm	12–16 mm	16–20 mm
Simmonds	3	8	14	10	–
Golden	7	19	7	2	–
Modified McBride	–	6	17	10	2
Wilson	3	6	19	6	1
Peabody	4	15	13	3	–
Mitchell	4	14	15	2	–
Joplin	31	4	–	–	–
McBride	26	9	–	–	–

Table 8. The most important factors influencing the results.

		Technical difficulty	Soft tissue trauma	Mobility of metatarso-phalangeal joint	Narrowing of forefoot	Relaxation of soft tissue	Stability of correction	Weight-bearing function of metatarsal arch	Totals
Basal osteotomy	Simmonds	2	3	4	2	5	1	2	19
	Golden	5	3	1	3	3	1	2	18
Shaft osteotomy	McBride	5	5	5	1	3	3	1	23
	Wilson	1	1	1	2	1	2	2	10
Neck osteotomy	Peabody	3	3	3	2	2	3	3	19
	Mitchell	3	3	3	2	3	3	3	20
Soft tissue procedures	McBride	5	5	5	3	4	4	2	28
	Joplin	5	5	5	4	5	5	2	31

A point system has been devised; the lowest score indicates the best situation.

Basis for point system;

Technical difficulty – two factors, tourniquet time and personal knowledge of the procedures.

Soft tissue trauma – personal knowledge of the dissection required.

Mobility of N.P. joint – average figures for total mobility. This was related to relaxation of soft tissues and degree of scarring of capsule and adjacent tissues.

Narrowing forefoot – average measurements pre- and post-operatively.

Relaxation of soft tissue – based on measurements of relative first and second metatarsal protrusion.

Stability of correction – based on incidence of recurrence of valgus and redisplacement of osteotomies.

Weight-bearing function – based on incidence of subsequent metatarsalgia and presence of callosities under the lateral metatarsal heads.

4. *Weightbearing by the first metatarsal head*

This is of particular importance in relation to osteotomies, for if there is any dorsal shift of the first metatarsal, pressure is shifted onto the lateral metatarsals with subsequent metatarsalgia. Thus, the problem is exchanged for another which may be even more disabling.

5. *The stability of the procedure*

It is important to maintain the advantages gained by surgery, and prevent relapse of the deformity. A point system was devised to compare all the above factors in relation to each procedure (Table 8).

Table 9. Patients' assessment of results.

Operations	Satisfied	Not satisfied
Simmonds	28	7
Golden	29	6
Modified McBride	22	13
Wilson	32	3
Peabody	27	8
Mitchell	30	5
Joplin	21	14
McBride	16	19

Table 10. Overall results after operation.

Operation	Excellent		Good		Poor	
	No. of feet	%	No. of feet	%	No. of feet	%
Simmonds	10	29	18	51	7	20
Golden	15	48	15	43	5	14
Modified McBride	12	34	8	23	15	43
Wilson	18	51	15	43	2	6
Peabody	12	34	11	32	12	34
Mitchell	16	46	12	34	7	20
Joplin	4	11	17	49	14	40
McBride	5	14	11	32	19	54

RESULTS

Tables 9 and 10 summarize the results.

Complications

These were few and suggest an overall high standard of surgery. Predictably there was a higher incidence of superficial infection following wound haematoma and adhesions in those procedures involving a good deal of soft tissue dissection—notably the McBride, modified McBride and Joplin operations. These all settled rapidly on simple measures. Other complications included non-union or displacement of the osteotomy (Figure 4 B, 5 A); over correction of the deformity was fortunately rare (Figure 3 B), as this was extremely difficult to deal with and finally relapse of the deformity as summarized in Table 5.

Table 11. Further 60 Wilson's operation analysed.*

Types	Number	Length of follow-up in years	Age in years	Result Excellent	Good	Poor
Adolescent Hallux Valgus	36	1–9	13–19	22 (61%)	9 (25%)	5 (14%)
Adolescent Hallux Valgus operated on at a later age	24	1–8	20–35	9 (38%)	13 (54%)	2 (8%)

* These cases were operated on at the Royal National Orthopaedic Hospital.

The Wilson shaft osteotomy

This operation had the best results; consequently we studied a further 60 cases. Table 11 shows the relevant findings. The poor results were mainly due to metatarsalgia associated with a dorsal shift or tilt of the first metatarsal head.

The chief technical faults were that the osteotomy had been cut at the wrong angle, or that it had not been sufficiently displaced. Too little displacement is easy to avoid, the surgeon merely has to make sure that he has divided the lateral periosteum. The angle of osteotomy is also critical and we saw a number of examples where it was too transverse or too oblique.

Often the metatarsal head had been allowed to tilt dorsally or to displace dorsally. To avoid this, one of us (B.H.) devised a modification of Wilson's technique (Figures 5 A, 5 B, 6).

The osteotomy is performed with an oscillating saw and commences at 45° to the main axis of the shaft of the metatarsal, just proximal to the exostosis, which, if large, is removed. The saw is also slanted so that the bone is sectioned obliquely plantarwise and proximally from the dorsum (Figure 6). This double oblique osteotomy prevents the dorsal tilting of the distal fragment, and also increases the area of contact at the bone ends, thus enhancing sound union. After displacement of the distal fragment laterally the medial projecting spike of the proximal fragment is shaved off to narrow the forefoot further.

The foot is bandaged with the great toe in a few degrees of varus. After two weeks the sutures are removed and a below knee walking plaster applied for a further four weeks.

We analysed a further 57 feet (32 patients) treated in this way; 52 feet were excellent and the other 5 good according to the criteria already mentioned (Table 3).

CONCLUSIONS

Our study suggested certain principles for a successful operation for adolescent hallux valgus. The procedure is best carried out in the early teens rather than later. Interference with the metatarso-phalangeal joint should be avoided. This joint apart from being valgus, is usually painless and fully mobile prior to operation. It is unjustifiable to destroy such a joint by arthrodesis or artroplasty, particularly in the growing foot.

Attempts to align the hallux on the metatarsal will alter the congruity of the metatarso-phalangeal joint surfaces and may give rise to stiffness, pain and possibly degeneration in later life. Soft tissue dissection interfering with the capsule or para-articular tissues will result in scarring and stiffness. Procedures which tighten the soft tissues by producing relative lengthening of the metatarsal will also produce stiffness of the metatarso-phalangeal joint. The adage that the more complex the procedure the worse the result seems to hold true for this type of surgery. The feature most valued after freedom from pain and good function is the ability to wear a fashionable shoe in comfort, so operations that narrow the width of the forefoot please the patient.

SUMMARY

Numerous operations for the correction of adolescent hallux valgus have been described. A comparison of the most popular surgical procedures currently practised in Britain has been carried out. The factors influencing the success or failure of these operations are discussed.

A consistently reliable procedure was found to be the metatarsal shaft osteotomy described by Wilson. Its merits are that it is technically simple, produces minimal soft tissue trauma and results in a good correction of the deformity. It narrows the forefoot, relaxes the soft tissues and retains excellent mobility at the metatarso-phalangeal joint.

Dorsal displacement of the metatarsal head may occur with subsequent stress on the lateral metatarsals producing metatarsalgia. This can be completely overcome by adding a second obliquity to the osteotomy.

ACKNOWLEDGEMENTS

We wish to thank the following surgeons for permission to review their cases: Mr. A. G. Apley, Rowley Bristow Orthopaedic Hospital; Mr. D. M. Dunn, Black Notley Hospital; Mr. P. R. French, St. Georges Hospital; Mr. G. N. Golden, Guildford Hospital; Mr. L. C. E. Gonet, Battersea General Hospital; Mr. N. T. Holden, Chase Farm Hospital; Mr. F. A. Simmonds, Rowley Bristow Orthopaedic Hospital; Mr. J. N. Wilson, Royal National Orthopaedic Hospital.

We would also like to thank the many orthopaedic surgeons, too numerous to list individually, who have contributed to this review.

We thank Mr. T. Bowen for the loan of his excellent unpublished monograph, "The treatment of hallux valgus".

We are indebted to Miss D. Bellamy for the typescript and cross-checking the references and to Mr. M. Moor for the photography.

We are grateful to the North East Metropolitan Regional Hospital Board for their grant towards this research.

REFERENCES

Akin, O. F. (1925) The treatment of hallux valgus—a new operative procedure and its results. *Med. sentinel* **33**, 678–679.

Albrecht, G. H. (1911) The pathology and treatment of hallux valgus (in Russian). *Russkij Vrach* **10**, 14–19.

Allan, F. G. (1940) Hallux valgus and rigidus. *Brit. Med. J.* **1**, 579–581.

Arredondo, F. O. (1946) Hallux valgus, tratamiento quirurgico, operacion de sacco. *Rev. Asoc. méd. argent.* **60**, 1009–1010.

Baker, L. D. (1953) Diseases of the foot, *American Academy of Orthopaedic Surgeons Instructional Course Lectures*, Vol. 10, Ann Arbor.

Balacescu, J. (1903) Un caz de hallux valgus simetric (in Rumanian). *Rev. Chir.* **7**, 128–135.

Balog, A. (1928) Entstehung und operation des hallux valgus. *Zbl. Chir.* **55**, 464–469.

Barker, A. E. (1884) An operation for hallux valgus. *Lancet* **i**, 655.

Bonney, G. & MacNab, I. (1952) Hallux valgus and hallux rigidus, a critical survey of operative results. *J. Bone Jt Surg.* **34**-B, 366–385.

Bourdillon, J. (1958) Butler's operation for hallux valgus. *J. Bone Jt Surg.* **40**-B, 346.

Bowen, T. The treatment of hallux valgus. Unpublished.

Carr, C. R. & Boyd, B. M. (1968) Correctional osteotomy for metatarsus primus varus and hallux valgus. *J. Bone Jt Surg.* **50**-A, 1353–1367.

Chapchal, G. (1941–43) Zur operativen Behandlung des hallux valgus. *Z. Orthop.* **34**, 47–60.

Cotton, F. J. (1935) Foot statistics and surgery. *Trans. New Engl. surg. Soc.* **18**, 181–208.

Daw, S. W. (1935) An unusual type of hallux valgus (two cases). *Brit. med. J.* **2**, 580.

Durman, D. C. (1957) Hallux valgus. *J. Bone Jt Surg.* **39**-A, 221.

Ellis, V. H. (1951) A method of correcting metatarsus primus varus; a preliminary report. *J. Bone Jt Surg.* **33**-B, 415–417.

Fuld, J. E. (1917) Surgical treatment of hallux valgus and its complications. *Amer. Med. (Philad.)* **14**, 536–537.

Gibson, J. & Piggott, H. (1962) Osteotomy of the neck of the first metatarsal in the treatment of hallux valgus. *J. Bone Jt Surg.* **44**-B, 349–355.

Girdlestone, G. R. & Spooner, H. J. (1937) A new operation for hallux valgus and hallux rigidus. *J. Bone Jt Surg.* **19**, 30–35.

Goebell, R. (1927) Uber arthroplastische freie fascien und Aponeurostransplantation nach Martin Kirschner. *Arch. klin. Chir.* **146**, 462–509.

Golden, G. N. (1961) Hallux valgus, the osteotomy operation. *Brit. med. J.* **1**, 1361–1365.

Hardy, R. H. & Clapham, J. C. R. (1951) Operations on hallux valgus. *J. Bone Jt Surg.* **33**-B, 376–391.

Hiss, J. M. (1931) Hallux valgus, its causes and simplified treatment. *Amer. J. Surg.* **11**, 50–57.

Hohmann, G. (1921) Sympomatische oder physiologische Behandlung des hallux valgus. *Münch. med. Wschr.* **33**, 1042–1045.

Hueter, C. (1871) *Klinik der Gelenkkrankheiten*, 1st ed. pp. 339–351. F. C. W. Vogel, Leipzig.

Hulbert, K. F. (1955) Compression clamp for arthrodesis of the first metatarsophalangeal joint. *Lancet* **i**, 597.

Jones, A. R. (1948) Hallux valgus in the adolescent. *Proc. roy. Soc. Med.* **41**, 392.

Joplin, R. J. (1950) Sling procedure for correction of sply foot, metatarsus primus varus and hallux valgus. *J. Bone Jt Surg.* **32**-A, 779–785.

Joplin, R. J. (1958) Some common foot disorders amenable to surgery. *Amer. Acad. Orthop. Surg.* **15**, 144–158.

Juvara, E. (1919) Nouveau procede pour la cure radicale du "hallux valgus". *Presse méd.* **40**, 395–397.

Kelikian, H. (1965) *Hallux valgus and allied deformities of the forefoot and metatarsalgia*, p. 271. W. B. Saunders Company, Philadelphia and London.

Keller, W. L. (1904) The surgical treatment of bunion and hallux valgus. *N.Y. Med. J.* **80**, 741–742.

Kleinberg, S. (1932) Operative cure of hallux valgus and bunions. *Amer. J. Surg.* **15**, 75–81.

Komza, J. (1950) The operations of the big toe (in Polish). *Pol. Przegl. chir.* **22**, 153–170.

Lapidus, P. W. (1934) The operative correction of the metatarsus primus varus in hallux valgus. *Surg. Gynec. Obstet.* **58**, 183–191.

LeLievre, J. (1952) *Pathologie du pied*, pp. 755–767. Masson et Cie, Paris.

Lenggenhager, K. (1935) Eine neue operations methode zur behandlung des hallux valgus. *Chir. Z.* **7**, 689–692.

Lexer, E. (1919) Die freien Transplantationen. *Neue deutsche chirurgie*, pp. 398–402. F. Euke, Stuttgart.

Logroscino, D. (1948) Il trattamento chirurgico dell 'alluce valgus. *Chir. Organi Mov.* **32**, 81–96.

Loison, F. (1901) Note sur le traitment chirurgicale du hallux d'apres l'etude radiographique de la deformation. *Bull. Soc. Chirurgiens Paris* **27**, 528–531.

Ludloff, K. (1918) **Die Beseitigung des hallux valgus durch die schraege plantodorsale osteotomie des metatarsus 1. (Erfshrungen und Erfolge).** *Arch. klin. Chir.* **110**, 364–387.

McKeever, D.C. (1952) **Arthrodesis of the first metatarso-phalangeal joint for hallux valgus, hallus rigidus and metatarsus primus varus.** *J. Bone Jt Surg.* **34**, 129–134.

Massart, R. (1948) *Affections medicales et chirurgicales de pied*, pp. 76–82. G. Doin & Co., Paris.

Mau, C. & Lauber, H. T. (1926) Die operative behandlung des hallux valgus, (Nachuntersuchungen). *Dtsch. Z. Chir.* **197**, 363–377.

Mauclaire, P. (1924) Osteoplasties, arthroplasties et transplantations tendineuses combinees pour traiter l'hallux valgus. *Rev. Orthop.* **31**, 305–313.

Mayo, C. H. (1908) The surgical treatment of bunions. *Ann. Surg.* **48**, 300–302.

Mikhail, I. K. (1960) Bunion, hallux valgus and metatarsus primus varus. *Surg. Gynec. Obstet.* **11**, 637–646.

Mitchell, C. L., Fleming, J. L., Allen, R., Glenny, C. & Sanford, G. A. (1958) Osteotomy—bunionectomy for hallux valgus. *J. Bone Jt Surg.* **40**-A, 41–60.

Mommsen, F. (1953) Eine neue operations methode zur behandlung der leichten forman des hallux valgus. *Dtsch. Gesdundh-Wes.* **8**, 121–123.

Mizuno, S., Sims, Y. & Yamazski, K. (1956) Detorsion osteotomy of the first metatarsal bone in hallux valgus. *J. Jap. Orthop. Ass.* **30**, 105–110.

Mygind, H. B. (1953) Some views on the surgical treatment of hallux valgus. *Acta orthop. scand.* **23**, 152.

Peabody, C. W. (1931) The surgical cure of hallux valgus. *J. Bone Jt Surg.* **13**, 272–282.

Petri, C. (1940) Zur behandlung von Vorfussdeformitaeten. *Z. Orthop.* **70**, 343–349.

Prignacchi, V. & Zanasi, R. (1957) La tecnica di Hueter-Mayo nella cura chirurgical dell'alluce valgo. *Chir. Organi Mov.* **44**, 234–242.

Reverdin, J. (1918) Anatomie et operation de d'hallux valgus. *Int. med. Cong.* **2**, 408–412.

Riedl, A. (1909) Osteotomie des keilbeines bei hallux valgus. *Arch. klin. Chir.* **88**, 565–575.

Sazepin, T. (1923) Operative therapie des hallux valgus. *Zbl. Chir.* **53**, 134–138.

Silver, D. (1923) The operative treatment of hallux valgus. *J. Bone Jt Surg.* **5**, 225–232.

Simmonds, F. A. & Menelaus, M. B. (1960) Hallux valgus in adolescents. *J. Bone Jt Surg.* **42**-B, 761–768.

Soresi, A. L. (1931) The medical cure of hallux valgus (bunion). *Surg. Gynec. Obstet.* **52**, 776–777.

Stamm, T. T. (1957) Surgical treatment of hallux valgus. *Guy's Hosp. Rep.* **106**, 273–279.

Stanley, L. L. & Breck, L. W. (1935) Bunions. *J. Bone Jt Surg.* **17**, 961–964.

Stein, H. C. (1938) Hallux valgus. *Surg. Gynec. Obstet.* **66**, 889–898.

Trethowan, J. (1923) *Hallux valgus, in a system of surgery*, pp. 1046–1049. P. B. Hoeber, New York.

Waugh, W. (1963) Mitchell's operation for hallux valgus. *Proc. roy. Soc. Med.* **56**, 159–162.

Wertheimer, V. (1959) Our experience with functional stabilisation of hallux valgus (in Serbian). *Acta chir. iugosl.* **6**, 236–244.

Wilhelm, R. (1934) Ein einfachs operationsver fahren bei hallux valgus. *Zbl. Chir.* **61**, 2424–2425.

Wilson, C. L. (1958) A method of fusion of the metatarso-phalangeal joint of the great toe. *J.Bone Jt Surg.* **40**, 384–385.

Wilson, J. N. (1963) Oblique displacement osteotomy for hallux valgus. *J. Bone Jt Surg.* **45**-B, 552–556.

Correspondence to:

B. Helal, M. Ch (Orth) F.R.C.S.
The London Hospital and the Enfield Group of Hospitals
London, England