OSTEOTOMY OF THE TIBIA AND FIBULA IN THE TREATMENT OF CHRONIC OSTEOARTHRITIS OF THE KNEE

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Nihil Scriptum Miraculi Causa

OSTEOTOMY of the tibia alone as an operation simply to correct deformity at the knee was described and performed by Volkmann as long ago as 1875; at about the same time as Lister and MacEwan (1878) gave their description of the first supracondylar osteotomy. This operation is also mentioned in *Orthopaedic Surgery* (Jones & Lovett, 1929) in relation to the treatment of knock-knee and bow-leg deformity in adult patients who had suffered from rickets in childhood. This procedure, modified in that the bone is divided horizontally through the inner tuberosity just distal to the articular surface, has been advocated within quite recent years by Smillie (1946). It is also mentioned by Judet, Judet, Lagrange and Dunoyer (1954). My colleague G. E. Thomas (1964) also regards it as correct practice in patients whose painful arthritic knees show a valgus deformity and maintains that this deformity can be corrected by a tibial osteotomy alone.

Osteotomy of the tibia combined with division of the fibula was first performed, to my knowledge, at the Royal Southern Hospital, Liverpool, from 1928 onwards. The surgeons who practised it at that time had usually to deal with deformity of the knee in adults, the result of childhood rickets. This was common in those times. They pointed out that correction of this deformity in adult life by femoral osteotomy, which was so successful in children, invited the rapid onset of pain and chronic degenerative change in the knee joint. They gave the reason that correction of the deformity above the knee joint altered the inclination of the axis of movement of that joint to the line of weight-bearing in the leg as a whole; and that whereas a growing child could accommodate to this, an adult could not. Osteotomy below the knee makes no such alteration but corrects the position by the production of an equal and opposite deformity below the original one

and leaves the axis of movement of the knee joint at the same inclination to the weight-bearing line of the limb.

The application of this procedure to the treatment of chronic osteoarthritis of the knee is of later date. It is described by Steindler (1940). As far as the series of patients quoted in this article is concerned the operation was first performed in 1941 with the single objective of correction of increasing deformity in painful and progressive degeneration of the knee. At that time certain authorities regarded this operation as dangerous because of the possibility of vascular complications and even gangrene of the limb, which had been observed to occur in certain fractures involving the tuberosities of the tibia and the proximal shaft of the fibula. This catastrophe need not be anticipated provided proper care is exercised. The rapid relief of pain observed in patients treated in this manner led to the increasing use of the operation. It is now also advocated by other authors (Jackson & Waugh, 1961) and a proportion of the patients described here have previously been reported elsewhere (Wardle, 1962).

Material

The majority of the 35 patients (Table 1) reported here presented with osteoarthritic knees in which varus deformity was associated with persistent and intractable pain which suddenly increased beyond that which they had been accustomed to bear for years with the aid of analgesics and physiotherapy. It is plain from other authors that as many patients may present with valgus deformity. Their ages have ranged from 42 to 75; 19 of them were men and 16 women. Pain and deformity were constantly associated with gross synovial thickening, periodic effusion of fluid in the joints and coarse creaking. The range of active movement present before treatment has rarely been less than 90 degrees of flexion from the extended position. The radiographs (Fig. 1) illustrate a typical knee joint at the time of operation.

Technique

Two skin incisions are used. The first commences just distal to the tibial tubercle and

TABLE 1

Name	Age at Operation	Deformity	Period of Immobilisation of Knee	Post-operative Range of Movement	
Mrs. T.	63	Varus	8 Weeks	90°	
Miss L.	50	Varus	12 Weeks	90°	
Mrs. B.	65	Varus	8 Weeks	Full	
Mr. P.	70	Varus	8 Weeks	Full	
Mr. B.	60	Varus	8 Weeks	Full	
Mr. W.	68	None	8 Weeks	90°	
Mr. B.	65	Varus	12 Weeks	Full	
Mr. W.	43R : 51L	Varus : Varus	12 Weeks : 7 Months	Full : Full	
Mr. D.	63	Varus	12 Weeks	90°	
Mrs. M.	62	Varus	12 Weeks	90°	
Mrs. N.	71	Varus	16 Weeks	Full	
Mr. B.	42	Varus	12 Weeks	Full	
Mrs. C.	66	Valgus	12 Weeks	90°	
Mr. K.	50	Varus	12 Weeks	90°	
Mr. A.	61L : 62R	Varus : Varus	8 Weeks : 10 Weeks	70° : 90°	Coronary Incident
Mr. McP.	59	Varus	8 Weeks	90°	
Mrs. H.	54	Valgus	12 Weeks	100°	
Mr. D.	50	Varus	12 Weeks	90°	
Mr. L.	50	Varus	10 Weeks	Full	
Mr. K.	62L : 63R	Varus : Varus	12 Weeks : 8 Weeks	70° : 100°	
Mrs. B.	73	Varus	12 Weeks	70°	
Mrs. A. B.	60	Valgus	8 Weeks	90°	
Mrs. C.	72	Varus	8 Weeks	45°	
Mr. P.	61	Varus	8 Weeks	Less than 90°	Coronary Incident
Miss P.	54	None	8 Weeks	None	Rheumatoid
Mrs. K.	61	None	8 Weeks	Full	
Mr. H.	58	Varus	8 Weeks	Full	
Mr. T.	67	Varus	8 Weeks	45°	
Mr. W.	49	Varus	—	—	Death from Coronary
Mrs. C.	67	Varus	8 Weeks	Less than 90°	Thrombosis
Mrs. R.	56	None	8 Weeks	Less than 90°	
Mrs. McD.	55	Varus	8 Weeks	90°	
Mr. H. J.	75	None	10 Weeks	Full	Paget's Osteitis
Mrs. P. D.	74	Varus	—	—	Wearing caliper
Mr. E. Y.	60	Varus	12 Weeks	90°	

extends distally for three inches, curving a little laterally so that at no time does it lie directly over the subcutaneous border of the tibia. The flap thus marked is reflected medially to expose the crest of the tibia and its subcutaneous surface at a point two inches distal to the tibial tubercle. The lateral surface of the tibia is cleared of muscle by a rougine and a bone lever inserted until its tip passes around the posterior border of the bone. A second bone lever is inserted at the medial border of the subcutaneous surface of the tibia in a similar manner. The line of osteotomy is then notched out of the hard cortical bone, particularly at the subcutaneous border, to prevent splintering and the tibia is then divided. The second incision is made on the lateral surface of the leg directly over the shaft of the fibula and at the same level as the first. The fascia is divided in the same line and the peroneal muscles are separated by blunt dissection to avoid damage to the

branches of the peroneal nerve; bone levers are inserted and the fibula divided a little distal to the site of the tibial osteotomy. The operation can be performed easily without a tourniquet in elderly patients. After closure of the incisions any deformity present is corrected and a long leg plaster cast is applied. Clinical union may be expected in six to eight weeks and can be expedited by encouraging the patient to bear weight on the cast. A below knee plaster is substituted when union is present. Internal fixation may be used to avoid plaster fixation but it is doubtful whether patients achieve weight bearing any earlier or recover their movement any more quickly by this method.

Immediate Results

All patients in this series have reported complete relief of their pain, in particular of their intractable night pain, within a few days

Postgrad Med J: first published as 10.1136/pgmj.40.467.536 on 1 September 1964. Downloaded from <http://pmj.bmj.com/> on April 25, 2023 by guest. Protected by copyright.

FIG. 1.—Two radiographs. Antero-posterior and lateral views of an osteoarthritic knee before operation, to illustrate diminution of joint spacing, osteophyte formation and changes in bone architecture.

of operation and there has been no recurrence. Twenty-seven of these patients had recovered the minimum range of 90 degrees of active flexion in the knee joint by six months from the time of operation, many of them at three months. A considerable proportion have achieved a full range although movement was limited before operation. At an interval of two years the disappearance of synovial thickening is a striking feature and crepitus is markedly diminished. Later, radiological changes occur in the proximal part of the

tibia. Normal bone architecture and density re-appear and cysts disappear (Fig. 2).

Complications

There have been no immediate complications in any of these patients during the first four post-operative weeks, which is in keeping with a simple operation. The advanced age of many patients would lead one to expect a number of coronary thromboses and pulmonary emboli. However there have been only three such events, in patients numbered 14, 18 and 29, all of them comparatively young men.

FIG. 2.—Two radiographs. Antero-posterior views of a knee joint.
 (a) 31.7.61—before operation. (b) 17.12.62—the same knee joint eighteen months later, to illustrate the change in joint spacing, bone architecture and density.

Non-Union

This has been observed once. The patient, young in years but with advanced degenerative changes in his knee joints, presented in 1949. Osteotomy of the tibia and fibula was performed on the left leg at that time. The result was sufficiently successful to return him to work and to bring him back requesting the same procedure for his right knee in 1957. When observed in 1962 there was non-union of the right tibia at the site of the osteotomy, but he was pain free and had a range of 120 degrees of active flexion from full extension in both knees. He was at work and walked without sticks.

Oedema of the Leg

All patients have shown this in the first few weeks following removal of all external support from the limb. A firm bandage, remedial exercises, periodic elevation of the

limb and effleurage together with a graduated increase in the period of weight bearing have usually been sufficient to remove the swelling rapidly. The three patients with cardiovascular complications were notable exceptions.

Wound Infection: This has not occurred in this series.

Muscle Hernia: There have been two examples of this. Both patients had gross deformity and were obese, and it was found impossible to close the fascial envelope of the peroneal muscles at the fibular incision without gross tension.

Late Results

In patients examined more than five years from the time of operation certain phenomena have been consistently observed. Clinically there is a striking reduction in soft-tissue

FIG. 3.—Two radiographs. Antero-posterior and lateral views of a tibia and fibula illustrating the medullary barrier.

synovial swelling. Radiologically the architecture of the tibial bone proximal to the site of the osteotomy tends to return to normal and joint spacing increases. The most successful cases, in which there has been restoration of full movement, are associated with the appearance of a medullary barrier in the tibia at the site of osteotomy (Fig. 3).

The lasting success of such a simple operation as osteotomy in the treatment of chronic osteoarthritis of the hip and knee raises the inevitable question—in what way does an osteotomy relieve pain and what are the physiological changes set in motion which repair the joint? No satisfactory explanation has yet appeared but certain observations which have been made, particularly in rela-

tion to osteotomy of the tibia and fibula, have lead to investigations which may be useful.

Investigations and Discussion

The rapid relief of pain in chronic osteoarthritis of the hip which follows intertrochanteric osteotomy has become a commonplace. The same phenomenon occurs in chronic osteoarthritis of the knee following osteotomy of the tibia and fibula. In this area of bone however, it is more easily observed that division of the tibia is constantly associated with the out-pouring of dark venous blood from the medulla; this is particularly so in elderly patients in whom the operation has been performed without a tourniquet. This

FIG. 4.—Two radiographs. Lateral views of the tibia following intra-osseous venography.

(a) The appearance in the tibia of an osteo-arthritic knee.

(b) The appearance in the tibia of an unaffected knee joint from a patient 70 years old.

appearance of venous blood suggested that the relief of intra-medullary venous pressure might be associated with the relief of pain.

In practice no reliable method of estimating the intra-medullary venous pressure has been found. Nevertheless, venous engorgement does exist within the medullæ of bones distal to chronic osteoarthritic knee joints in many patients, and certain observations (Brookes, Elkin, Harrison and Heald, 1961), which show that no valvular obstruction exists between the bone medulla and the main venous trunks of the limb, suggested that simple venous stasis might have some bearing on the matter.

This has been investigated clinically and radiologically (Helal, 1962). In all patients treated for chronic osteoarthritis of the knee at the David Lewis Northern Hospital during 1962 there was a greater percentage with associated varicose veins in the affected leg than in a comparable number of patients treated for other conditions.

Radiologically the possibilities of intra-osseous venography (Schobinger, 1960) have been explored. This is a technique originally

described for the delineation of main venous channels in a limb. It has been modified to produce a pattern of the venous network within bone. The procedure has proved safe and useful. The patient is tested for sensitivity by the injection of 1 cc. 45 per cent Hypaque six hours before operation. Under anaesthesia, before the osteotomy is commenced, a self-tapping cannula (Helal, 1962) is screwed into the tibial medulla and the backflow of medullary blood is noted. 10 ccs. of 45 per cent Hypaque are then injected into the tibia and an X-ray taken just as the injection is completed. Fig. 4 shows the type of venogram obtained in an established osteoarthritic knee contrasted with that obtained from the tibia of a patient from whose knee a large ganglion was being removed. This latter picture can probably be regarded as a normal intraosseous venogram. Provided that the radiograph is taken immediately the injection is completed this venous pattern in the bone can be obtained, although it does not appear in any of Schobinger's illustrations, where radiography was delayed. Undoubtedly, there

is evidence of venous sinusoidal engorgement in the tibia subjacent to an osteoarthritic knee.

At an interval such as two years from the time of operation the radiographs of the tibiæ of many patients subjected to osteotomy show a medullary block (Fig. 3). The appearance of this barrier suggests that some alteration in the pattern of venous flow, or in the amount of venous blood contained in the bone occurs, which has a relationship with the relief of symptoms and the late changes in bone produced by the operation of osteotomy. It is interesting to observe that several years after osteotomy the venogram obtained from

the tibia of an osteoarthritic knee returns to the pattern regarded as normal.

It would seem, therefore, that in order to relieve the pain of an osteoarthritic knee joint it is necessary to open the medullary cavity of the tibia distal to that joint. To maintain this relief of pain it is necessary to create a barrier across the medulla isolating its proximal part from any connection with the main venous outflow from the shaft of the bone as a whole. Osteotomy of the tibia produces this block naturally by bone as in the healing of any fracture. When the osteoarthritis of the knee joint is associated with deformity it is necessary to add an osteotomy of the fibula to correct this deformity as well as to relieve the pain.

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