The Journal of Bone and Joint Surgery

EDITORIALS AND ANNOTATIONS

SURGICAL TREATMENT OF UNUNITED FRACTURES

From the point of view of basic science the experimental material in the paper by Leo Jarry and Hans K. Uhthoff, published in this issue of the Journal, is quite convincing and therefore should be available in a scientific archive for other workers in this field. From the point of view of the clinician there are features which may cause some disquiet if acceptance by this Journal is mistaken as approval for clinical trial on human subjects. Without wishing to belittle this contribution, the Editorial Board considered that an annotation on this subject might help to establish historical perspective. In clinical trials of any new method for uniting a pseudarthrosis we have to be more than usually cautious, because patients with a pseudarthrosis usually have already passed a considerable portion of their span of active life as invalids and usually they have already suffered one or two disappointments after previous operations.

We have to bear in mind that the problem is the treatment of the fully established pseudarthrosis, and this experimental work on rats is concerned with much more recent fractures than is customary with the true pseudarthrosis. We have to bear in mind that this experimental work on rats was done with an intramedullary nail in position, yet the authors consider that for a human pseudarthrosis it would suffice to "reactivate" the bone ends by the "petal" method and that it would suffice thereafter to immobilise the fragments with nothing more effective than a plaster.

The greatest value of this paper lies in the emphasis it lends to the biological approach to osseous union as opposed to the purely mechanical attitude. Orthopaedic surgeons are drawn together by their delight in engineering techniques and precision instruments; the epoch of Albee, though involving craftsmanship akin more to the cabinetmaker than the engineer, has generated an affection for certain operative procedures which are hard to abandon. It is sad to forgo the pleasure of making a close-fitting inlay graft and sad never more to shape a cortical graft and fix it to a carefully prepared bed, with all the pleasant tricks of drilling and sawing, to end with the final satisfaction of good work well done when all screws are finally driven home. To exchange the skill acquired in this type of bone grafting for the crude procedures of the "petal" technique might seem a retrograde step; but whether we like it or not we shall have to face the fact that a growing body of opinion is favouring techniques similar to, if not identical with, the "petal" method.

The idea that the ends of the bones can still possess a potential for osseous union even in a pseudarthrosis, a potential which can be released by a relatively trivial operative procedure, was known to a minority of surgeons many years ago. In England we credit Elmslie, as reported by Jackson Burrows (1940), with teaching in the early 1920's that it was unnecessary to resect bone ends or remove intervening fibrocartilaginous tissue when grafting a pseudarthrosis and using a simple inlay without screws or metallic internal fixation. An even more dramatic demonstration of osteogenic potential in a pseudarthrosis was demonstrated by Naughton Dunn (1939), who considered a bone graft to be unnecessary and that to treat non-union it sufficed merely to turn up flakes of periosteum-covered bone in a manner which he called his "subcortical procedure," which nowadays is commonly called "shingling."

The success of this method depended on preserving intact the fibrocartilaginous material between the bone ends. Phemister arrived at these same conclusions and his paper (1947), probably more than any other, drew attention to the fact that there were simpler and safer methods than the massive cortical graft with screw fixation which at that time was tending to be regarded as the most desirable form of treatment. Phemister used slices of cortical bone laid subperiosteally on one side of the ununited fracture and it was a natural step to find autogenous iliac bone superior for this purpose. The ability of cancellous bone to survive, in whole or in part, in the presence of slight infection has rendered it possible to graft successfully by this technique ununited fractures which have been recently compound and infected.

The fundamental idea underlying this approach to the treatment of non-union is that the fibrocartilaginous tissue intervening between the bone ends does not appear to be the fully differentiated tissue which in the past it was assumed to be, and once the fibrous union has been bridged by a slender graft the gap between the ends of the bones will fill with bone and disappear. It might be suggested that the graft could have some sort of "catalytic" action on the fibrous tissue interposed between the ends of the bones, but a more likely explanation of the disappearance of the fracture gap is that it is another example of Wolff's Law. Wolff's Law cannot start to operate until continuity of bone has been established, and continuity can be considered to be established even though it is through the most precarious of bridgeheads. Once osseous continuity has been achieved, even though by a devious route which circumvents the fracture, the action of normal physical stresses over a long time will cause the bony architecture of the part to return to normal.

We see therefore that there is considerable past clinical experience to support some of the ideas advocated by Jarry and Uhthoff and of which this paper serves as an opportune reminder; but there are also important details which must not be overlooked. To preserve intact the ossifiable fibrocartilaginous tissue between the bone ends, which is common to the methods just mentioned, and which may be the essential source of their success, has been discarded by Jarry and Uhthoff, because the "petal" technique cannot be performed without full exposure of the ends of the bones.

A successful result after any operation for fully established pseudarthrosis, where the bone ends are densely sclerosed and avascular and where a synovial cavity may be developed, is never achieved with much of a margin for success. One cannot lightheartedly say that there is no need for internal fixation in a pseudarthrosis possessing a free range of movement in the false joint. The best way to manage a pseudarthrosis is to prevent its developing. The use of iliac cancellous bone, applied as subperiosteal slices after the manner of Phemister, is so free from the danger of serious sepsis that it can be contemplated very much earlier than was customary in the use of massive onlay grafts of autogenous cortical bone. Subperiosteal grafts applied in cases of delayed union can prevent the development of pseudarthrosis, and the success rate is much higher than that of any method of treating the fully developed pseudarthrosis.

The paper of Jarry and Uhthoff is thus important in reminding us that the bone ends, in delayed union and in non-union, still possess osteogenic potential, and further experimental work to devise ways of exploiting this potential are strongly to be encouraged.

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REFERENCES

- BURROWS, H. J. (1940): Treatment of Ununited Fractures by Bone Grafting Without Resection of the Bone Ends. *Proceedings of the Royal Society of Medicine* (Section of Orthopaedics), **33**, 157.
 DUNN, N. (1939): Treatment of Ununited Fractures. *British Medical Journal*, **ii**, 221.
 PHEMISTER, D. B. (1947): Treatment of Ununited Fractures by Onlay Bone Grafts Without Screw or Tie Fixation and Without Breaking Down of the Fibrous Union. *Journal of Bone and Joint Surgery*, **29**, 946.