Oct. 4, 1955 S. S. HUDACK 2,719,522

ARTICULAR REPLACEMENT

Filed July 8, 1952

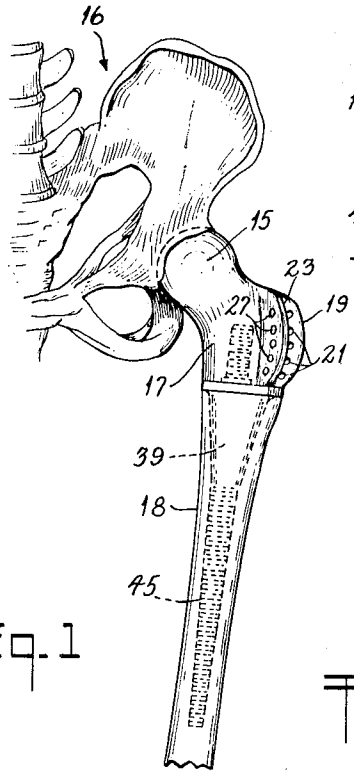

Fig. 1

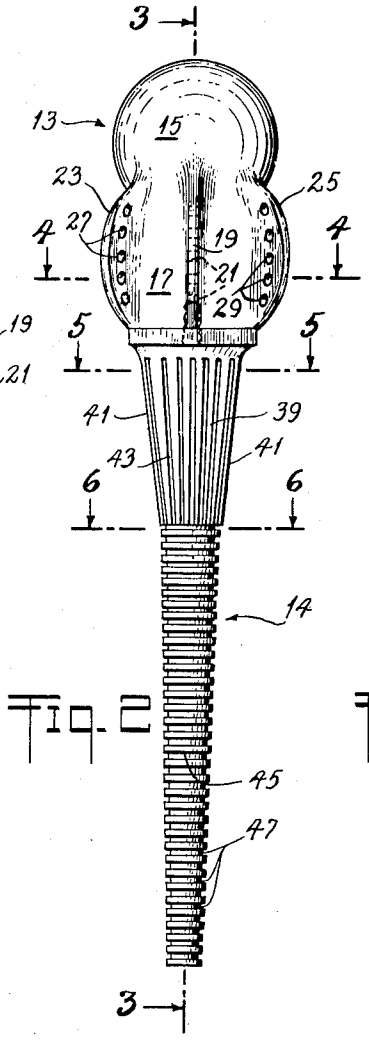

Fig. 2

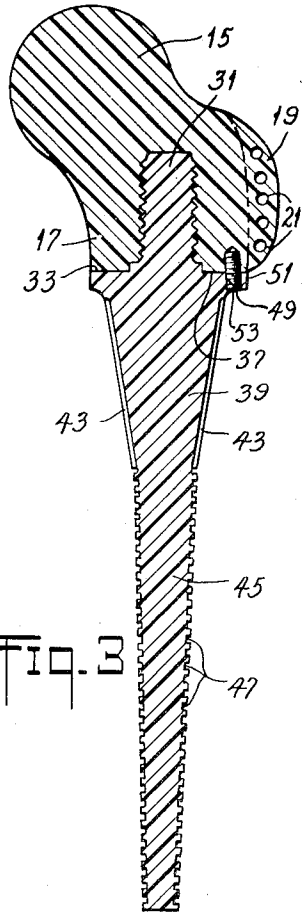

Fig. 3

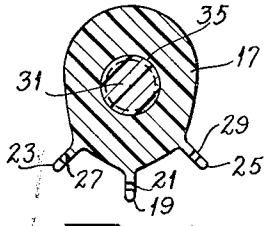

Fig 4

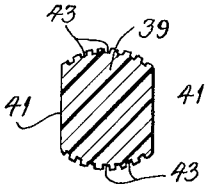

Fig. 5

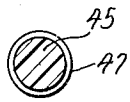

Fig. 6

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ARTICULAR REPLACEMENT

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5 Claims. (Cl. 128—92)

This invention relates to improvements in osteal appliances, and more particularly pertains to improvements in articular replacements for surgically excised bone.

Where it becomes necessary to excise surgically a part of a human bone and to replace the excised element with an osteal appliance, several desiderata must be considered. The structural strength of live bone must be provided in the resultant compound of live bone and replacement element. The replacement element must be able to withstand the constant minute vibratory muscular strains that will be imposed. Such element must also be unaffected by the highly corrosive chemical and electrolytic action in the body.

Particularly where an articular replacement is involved, there must be a dispersion of stress on the host tissue, as by decreasing the angle of the neck, expanding the surface area of the host tissue to avoid undue stress concentration and by elimination of screw-fixation techniques. Undisturbed vascular supply to the host tissue taking the compression strain must be maintained, since preservation of the bone element with impaired blood supply leads to necrosis and collapse. In addition, in femoral replacements, there must be maintenance or restitution of form and function, with preservation and reattachment, insofar as possible, of the ilio-psoas groups, the rectus femoris, the glutei groups, the tensor fascia femoris and the small external rotator muscles.

The principal object of this invention is to provide an osteal appliance affording a substantial equivalent and a substitute for surgically excised bone.

Another object is to provide an articular replacement for surgically excised bone.

Still another object is to provide an articular replacement substantially equivalent in structural strength, resistance to vibration, and chemically and electrolytically inert quality to human bone, wherein stress dispersion, affording of optimum vascular supply to the host tissue, and maintenance of restitution of form and function are achieved.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawing wherein:

Fig. 1 is an elevation of a portion of the ilium and a partially excised femur with fixation thereinbetween of an articular replacement, showing a preferred embodiment of the invention. (Relevant musculature is omitted for purposes of clarity.)

Fig. 2 is an enlarged side elevation of the articular replacement shown in Fig. 1;

Fig. 3 is a section taken on the line 3—3 of Fig. 2;

Fig. 4 is a section taken on the line 4—4 of Fig. 2;

Fig. 5 is a section taken on the line 5—5 of Fig. 2; and

Fig. 6 is a section taken on the line 6—6 of Fig. 2.

Similar numerals refer to similar parts throughout the several views.

The articular replacement comprises a head **13** and

shank **14** adapted to be seated in a femur **18** the upper portion of which has been excised. The head **13** is preferably a cured methyl methacrylate polymer having no undiffused monomers, dimers or trimers, no plasticizer contaminant, and no bubbles, craze marks or other evidence of internal strain. Said head **13** comprises a substantially spherical or bulbous femoral head portion **15** having substantially the diameter of the excised femoral head to assure facile articulation in the cotyloid cavity of the innominate bone **16**. Said head portion **15** flares into a substantially cylindrical throat portion **17** somewhat below the major dimension thereof, the axes of the head and throat portions defining an angle substantially equal to the corresponding angle of the excised portion of the femur.

A first fin or ear **19** that extends radially from the throat portion at the center of the lateral side thereof and flares into the head at all meeting surfaces is provided with a plurality of holes **21** for the insertion of selected muscles having their origin in the innominate bone. Additional fins or ears **23** and **25** extend radially from the throat portion, each at a radial angle of approximately 45° from the ear **19** to provide a general symmetry, and each of said ears **23** and **25** flares into the head at all meeting surfaces. A plurality of holes **27** in ear **23** and a plurality of holes **29** in ear **25** are provided for the insertion of selected muscles having their origin in the innominate bone.

The shank **14** is preferably a hexamethylene diamine adipate polymer such as the Dupont nylon formula 10,001 fabricated by the Polymer Corp. of Reading, Pa. It must be free of internal strain, quick-cooled to prevent crystallization that gives a predisposition to brittleness and radial fracture, and must be so fabricated as to be uncontaminated by other plastics or by other nylon formulas which may contain irritative impurities. Said shank **14** comprises a threaded stud **31** that extends above the upper face **33** to mate with an internally threaded bore **35** in the throat portion **17** and secure said shank in precise and coextensive abutment with the lower face **37** of the said throat portion **17**, a generally frusto-conical intermediate portion **39** having smooth opposed flats **41** and a plurality of symmetrical grooves or flutes **43** extending longitudinally along the surface thereof, and an elongated tapered end portion **45** having a plurality of annular grooves or flutes **47**. Said intermediate portion **39** and end portion **45** are integral elements characterized by a smooth transition with their respective meeting ends as shown in Figs. 1, 2 and 3. A threaded bore **49** extends through the upper shoulder **51** of the intermediate portion **39** and further extends into the throat portion **17** to receive a molybdenum stainless steel screw **53**, primarily to provide a reference marker to indicate post-operatively any rotation of the articular replacement and secondarily to prevent relative rotation of the head **13** and shank **14**.

The operative procedure recommended for articular replacement of the upper portion of the femur with the subject device comprises the steps of exposure, excision, seating and closure. In exposure, the anterior Smith-Petersen approach is preferred, since the lateral or posterior approaches do not seem to give enough access to the anterior and mesial acetabulum. Whenever possible, the rectus femoris and its attachment are saved. Adequate detachment from both faces of the innominate bone contributes to ease of dislocation, excision of the femur and revision of the acetabulum. The capsule is then excised as completely as possible to remove diseased and scar tissue and to allow for greater operative flexibility. The amount of femur to be excised is estimated, allowing for restitution of length where possible. (Unless there is tumor or destruction of the greater trochanter it should be preserved. The transection of the femur should be above the lesser

trochanter when possible. Accurate planographs or distortion-corrected X-rays of the normal side (if there is one) also aid in reconstructing to approximately the desired norm.) The estimated segment is then excised with or without dislocation, depending upon limitation of movement, posterior scarring deformation and other factors. Where the outer shell of the greater trochanter is saved, the excision of the posterior capsule is then completed. Essentially, such excision denervates the joint and reduces postoperative pain and muscle spasm, making active motion possible on the first postoperative day.

In seating the subject device, the marrow canal is opened and its peculiarities felt out with an intramedullary pin. The canal is prepared for the seating and the length of the open gap tested to be sure that the fit for the head element is not too snug and that reduction is possible after the seating of the intramedullary portion. The replacement element is seated with the patella straight up and the element rotated externally about 25 degrees. It is then reduced and tested for motion, snugness and stability. (In seating, if flexion and adduction contracture are present and long standing, the replacement element should be adapted to allow optimum motion. When the anterior acetabulur lip is hypertrophied, it should be revised surgically to allow unimpaired flexion. When the acetabulum is shallow, as in chronic dislocation, it should be deepened to give a stable socket. When the joint is fused or destroyed it should be re-formed surgically to proportions as nearly normal as possible. The marrow canal of the upper femur should be shaped to fit snugly the upper shank **39** to control torque, and the fit should be good but not tight. If fitting is difficult, the upper femur can be split part way longitudinally to expand the marrow canal. The split should of course, be lateral and not long enough to weaken the femur structurally.)

Completing the surgery with the closure, the motor flanges are settled into the trochanteric shell and sutured into place, pulling the shell anteriorly to snug up the gluteal aponeurosis. Where possible, the reflected lateral portion of the rectus femoris is utilized, being sutured to the anterior limit of the gluteal aponeurosis to stabilize against lateral slipping. The deep covering of the tensor fascia femoris is sutured to the lateral limit of the rectus femoris and the layers closed in. Where the foregoing reconstruction is deemed unstable, immobilization in plaster is effected. Otherwise, only a posterior shell with a cross bar to prevent rotation is used.

Postoperative roentgenograms, the objective and subjective postoperative indicia of restoration of function and alleviation of pain, and postmortem examinations have all supported the conclusion that the subject articular replacement accomplishes dispersion of stress on the host tissue, permits undisturbed vascular supply to the host tissue taking the compression strain and affords a striking maintenance or restitution of form and function. Progressive new-bone formations over the flats **41**, and in the flutes **43** and grooves **47** is deemed a salient factor in accomplishing these results.

The application of the subject invention to the problem of articular-replacement of the upper part of the humerus, as well as to other bone structure, is apparent. Obviously, many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

I claim:

1. In an articular replacement for a host bone formation consisting of articulated bone structures, a head element of which one bone structure of the formation is host and a shank element of which another bone structure of the formation is host, the head and shank elements being secured to each other rigidly, the shank element comprising a shoulder proximate to the head element and a conical portion extending away from the head element beyond the shoulder, the shank element comprising a tapered portion remote from the head element and extending beyond the conical portion to the end of the shank element, the conical portion comprising lands and grooves alternated circumferentially and extending lengthwise of the shank element, the tapered portion comprising lands and grooves alternated lengthwise and extending transversely of the shank element, the head element being contoured to articulate with its host bone structure of the formation, the shank element being adapted to be projected into the medullary canal of its host bone structure of the formation with its shoulder abutting against the excised end face of its host bone structure and supporting the head element in articulated relationship with its host bone structure of the formation.

2. In an articular replacement as defined in claim 1, the head and shank elements being separate pieces and comprising respective attaching devices companion to each other for securing the head and shank elements to each other rigidly.

3. In an articular replacement as defined in claim 1, the head element comprising devices located to be engaged by host musculature having origin in the host bone formation.

4. In an articular replacement as defined in claim 2, the head element consisting of a cured methyl methacrylate polymer, and the shank element consisting of a hexamethylene diamine adipate polymer.

5. An articular replacement comprising a head element having a bulbous portion adapted to be seated for articulation in the cavity of a host bone formation and having a cylindrical portion bearing a plurality of spaced radial fins, a plurality of holes in each of said fins adapted to receive host musculature having origin in said host bone formation, a shank element having a threaded stud extending from an end thereof inserted into a threaded bore in the cylindrical portion of said head element, said shank element having a longitudinally fluted substantially conical portion, opposed flats cut in said conical portion and an elongated tapered portion having a multiplicity of annular grooves subtended from said conical portion, said shank element being adapted to be inserted into the medullary canal of a host bone at the excised end face thereof, and a pin threaded through a portion of said shank element and into said head element.

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