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THE VALUE OF ELASTIC TENSION  
IN THE TREATMENT OF FIBROUS ANKYLOSIS

*ALSO THE DESCRIPTION OF AN APPARATUS  
FOR PRODUCING EXTENSION AND AT  
THE SAME TIME ROTATION OF  
THE FOREARM*

BY ✓

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CENTRAL NEW YORK MEDICAL ASSOCIATION; OF THE MONROE  
COUNTY MEDICAL SOCIETY, ETC.

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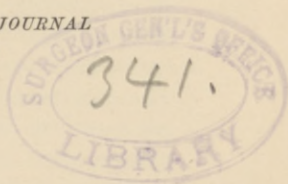
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PREVIOUS to the introduction of *brisement forcé*, or the forcible rupture of joint adhesions under anæsthesia, the treatment of fibrous ankylosis consisted of gradual extension or stretching by mechanical means. It has been said that the introduction of the former procedure marked a new era in surgery, and it was supposed that the slower method would be entirely abandoned. A calm and unprejudiced investigation of the results of *brisement forcé*, however, will show that it does not accomplish all that has been alleged for it, nor that it is so universally applicable as we are led to believe by the statements in some recent surgical works. It is a noticeable fact that *brisement forcé* is the only procedure spoken of for overcoming fibrous ankylosis, no reference being made to other plans of treatment. Gradual extension seems to have become, comparatively speaking, a lost art. Some distinguished surgeons, including Langenbeck, Dieffenbach, and others, pronounce gradual

\* Read before the Medical Society of the State of New York, February 9, 1888.

extension inefficient, painful, and not free from danger, and Bauer\* goes so far as to assert that "the superiority of *brisement forcé* over progressive extension can no more be questioned, and its former opponents have been effectually silenced by the overwhelming results of that practice." And yet it is well known that not infrequently violent inflammation and other untoward results supervene after the forcible rupture of joint adhesions, which certainly render ultimate success quite problematical, and increase the difficulty of restoring joint function.

The mechanical means formerly employed to produce extension or traction consisted of an endless screw, a rack and pinion movement, or similar contrivances. The defects of all appliances in which these principles are utilized are apparent; the use of rubber, however, is free from the objections which may justly be urged against an unyielding power, because it more nearly represents manual force and is continuous in its action. The value of elastic tension in fibrous ankylosis and other affections has been so fully demonstrated that nothing further need be added, except to urge its more extended use for such purposes.

In order to obtain the best results from the use of elastic tension, it is advisable to adopt a plan of treatment which will prepare a joint for the application of force, and also overcome those secondary changes in the surrounding parts that usually occur in joint affections. The therapeutic measures which constitute this treatment are local warm baths, massage, electricity, and wet packs. The two former are strongly advocated by Reibmayr, † of Vienna. He recommends the use of a local warm bath of from one half to one hour's

\* "Lectures on Orthopædic Surgery," by Louis Bauer, M.D., New York, 1868, p. 311.

† "Die Behandlung der Ankylosen und Kontracturen mit Massage und elastischem Zuge," von Dr. Albert Reibmayr, "Wiener med. Wochenschr.," No. 25, 1885, p. 795.

duration, and massage practiced for from ten to fifteen minutes previous to each application of the elastic tension. Massage may also be resorted to for increasing the nutrition of muscles. When employed for this purpose, more time should be devoted to the extensor than the flexor muscles, for it has been shown that in the majority of the diseases of the extremities the former become impaired to a much greater extent than the latter.

It is now an accepted fact that an electrolytic effect can be obtained by the surface application of a galvanic current. It is necessary, however, to localize the current—*i. e.*, to pass it directly through the parts to be acted upon. Many joints are accessible for an application of this kind, and the catalytic action that results therefrom hastens the dispersion or absorption of effusions and exudations, and softens fibrous adhesions. In addition to the use of galvanism, the slowly interrupted faradaic current is of great value in overcoming the muscular atrophy which usually accompanies joint affections. The beneficial effects of electricity depend upon the selection of a proper current, and its correct application and variation according to the requirements of each individual case; hence it should always be applied by the physician himself. The application of the galvanic current in particular should never be intrusted to a patient.

The use of a wet pack is indicated to relieve the hyperæmia or congestion which sometimes results from the application of force and causes pain or soreness in the joint. A wet pack also exerts a favorable influence on a diseased joint by its general derivative effect; hence it is a good plan to have one applied on retiring, and worn during the night. Upon removing it, the joint will be cool, less painful, and more mobile.\*

\* For a description of the physiological effects, and the mode of application of wet packs, *vide* Winternitz's "Hydrotherapeutics," in vol. v of v. Ziemssen's "Hand-book of General Therapeutics."

After a joint has been subjected to the preliminary treatment described above, it is in the best possible condition for the application of an apparatus for gradual extension. The length of time extension or traction may be continued must be determined by the peculiarities of each case, the condition of the joint, and the amount of force exerted. From one half to two hours will suffice, as a rule, for each application, and this may be repeated several times during the day. The amount of force exerted should never be so great as to cause severe pain.

In the following case, which came under my observation a short time ago, *brisement forcé* failed absolutely to improve the condition of the joint, while the use of elastic tension proved to be of great service, the patient now being able to extend the arm actively quite beyond a right angle. The range of motion is steadily increasing.

*Case.*—Miss G., aged twenty-one, sustained a dislocation of the right radius forward, which remained unreduced for ten days. An attempt was then made to reduce it under anæsthesia with apparent success; the arm was bandaged in a flexed position and allowed to remain so for ten days or two weeks; efforts at passive motion failed completely, the arm being firmly fixed in extreme flexion. An anæsthetic was again administered, the joint adhesions broken up, the hand placed in a semi-pronated position, and the arm bandaged as before. This dressing was allowed to remain unchanged for about two weeks, for the avowed purpose of bringing about an ankylosis, all hope of restoring joint function being now abandoned. When I first saw this case, about three months after the accident, I found the arm firmly fixed in the position last described, the patient being unable either to extend or rotate the forearm. According to the statement of the patient, each forcible manipulation was followed by violent inflammation, and after this had subsided the stiffness of the joint increased steadily from week to week.



The object to be accomplished by treatment in this class of cases is, of course, the restoration of the functions of extension and rotation, and an elastic tension apparatus is best adapted for the purpose. As no appliance has hitherto been constructed that meets all requirements, I devised an apparatus, which I herewith present for your inspection, that not only produces extension of the forearm, but rotation also, at the same time.

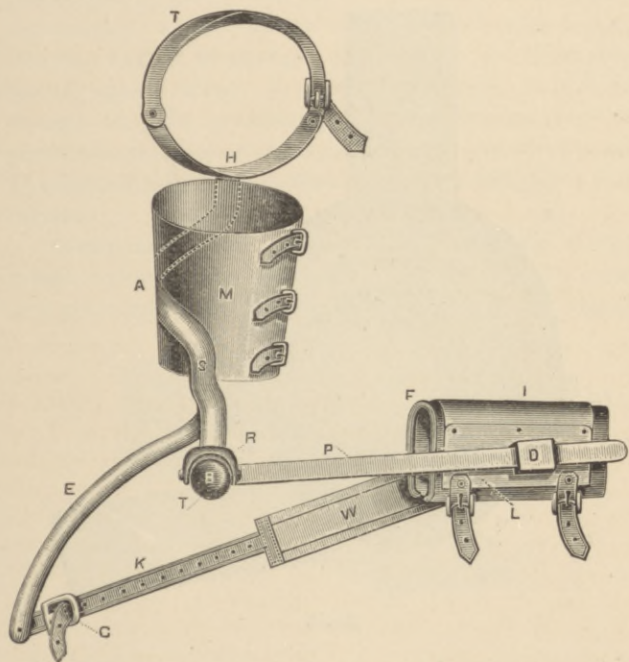


FIG. 1.

Fig. 1 shows a view of the complete instrument adapted for the right arm. It consists of two segments, *A* and *F*,

corresponding to the arm and forearm, which are connected together by a new compound joint, *T*.

The arm segment is constructed as follows: A flat steel bar, *S* (Fig. 1), is curved so as to pass from the outer side of the elbow in a spiral direction, around the back of the arm, to the axilla, where it ends in a crutch-head, *H*. At the lower end of this bar a fork, *R*, is fixed. Just above this fork a curved metallic arm or lever, *E*,\* passes back-

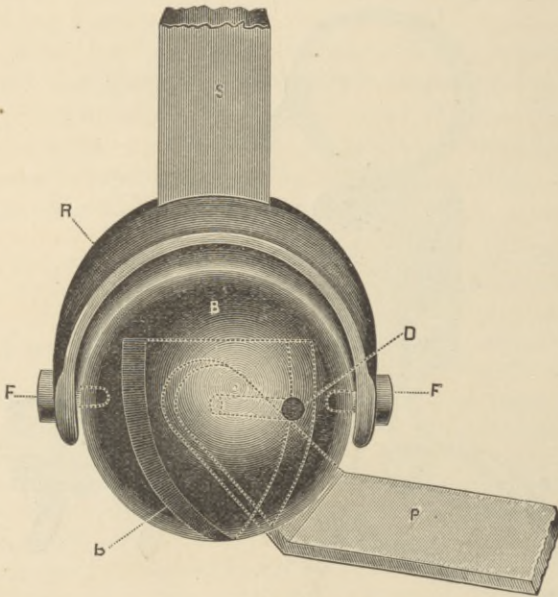


FIG. 2.

ward and downward, its free end carrying a pivoted buckle, *C*. The forearm segment consists of a flat steel bar, *P*, the

\* This lever is like that used by Dr. M. J. Roberts on several of his appliances.

free extremity of which passes through a slot in a metallic block, *D*, to which a wristlet, *L*, is pivoted. This wristlet is constructed of two metal plates united by a piece of leather, *l*, and lined with thick, soft felt. The two bars, *S* and *P*, are connected together by means of a new compound joint, *T*, a view of which is shown in Fig. 2. This consists of a ball, *B*,\* which turns freely on two axial bearings, *F*, passing through the prongs or arms of the fork, *R*, and is also hinged to the forearm shaft or piece, *P*, in the following manner: a deep and narrow slot or channel, *b*, is cut into the ball, *B*, at an angle of  $45^{\circ}$  from the above-mentioned axial bearings, *F*, and extends about two thirds through it. The proximal end of the forearm shaft, *P*, passes into this slot or channel, where it turns about a pin, *D*, which extends through the center of the ball and is fixed thereto.

To the inner metal plate of the wristlet a strip of stout rubber webbing, *W* (Figs. 1 and 3), is attached by means of a pivot, and ends in a strap, *K* (Fig. 1). The manner

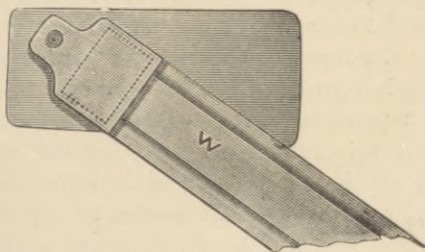


FIG. 3.

in which the webbing is attached to the metal plate is shown in Fig. 3.

\* In Fig. 2 the diameter of the ball is shown about a third greater than the real size.

The mode of fixing the apparatus to the arm is as follows: The segment, *S*, is riveted on a strong leather armlet, *M* (Fig. 1), which is provided with straps and buckles. A strap, *t*, also passes from one end of the crutch-head, *H*, around the shoulder, to a buckle at the other end. The segment for the forearm is attached by the wristlet, *L*, which is also provided with straps and buckles for fixing it firmly in position.

The essential and new features in the above-described apparatus are the mechanism or joint for producing extension and rotation simultaneously, the sliding forearm shaft, the peculiar construction of the wristlet, and the use of a crutch-head with shoulder-straps.

The manner in which simultaneous extension and rotation are obtained can be seen by examination of the compound joint or mechanism as shown in Fig. 2. It will be seen that the forearm shaft, *P*, is held in the oblique slot or channel, *b*, in the ball, *B*, by the pin, *D*, and must necessarily travel in it. Now, if any power is applied to the forearm segment which tends to force it downward, it not only causes the shaft to turn on the pin, *D*, and follow the direction of the slot from left to right, but also produces a rotation of the ball on its axis from right-to-left. When the movement permitted by the joint is completed, the forearm segment is fully extended upon the upper or arm segment and is directly continuous with it, occupying, however, a plane at right angles to it; in other words, a rotation through about  $90^\circ$ , as well as extension, has taken place. If the slot were cut at right angles with the axial bearings, *F*, instead of obliquely thereto, extension alone would result, as the shaft could move in one plane only; it would be simply a hinge. This is well illustrated in the joints of an ordinary folding pocket-rule.

In a mechanical appliance which is intended to produce

extension and rotation of the forearm, a shaft which may change its position and direction becomes necessary for the following reasons: During extension of the forearm, a lengthening, equal to one half the diameter of the convex articular surface of the humerus, takes place. Furthermore, in pronation, the head of the radius rotates upon its own axis, while its carpal end, owing to the longitudinal curve of the shaft of the bone, describes an arc of a circle, and becomes twisted obliquely across the ulna, carrying the hand with it. In the above-described apparatus the forearm shaft, *P*, slides through the pivoted block, *D*, on the wristlet, and hence it can change its position and direction automatically.

At the anterior third of the forearm the bones are quite superficial, and hence favorably situated for the application of force. Now, inasmuch as this portion of the arm is elliptical in cross-section, it will be seen that a wristlet constructed in the manner above described conforms itself readily to this shape, and grasps the arm firmly, so that it can not change its position without carrying the arm with it. In the movements of extension and rotation the humerus is the fixed bone, while the radius and ulna are movable ones. A mechanical appliance for producing similar movements must have a fixed part from which motion proceeds, and it is apparent that the more perfect the fixation is, the greater will be the power of the movable portion of an apparatus. For this reason I have added a crutch-head with shoulder-strap, as the straps and buckles of the armllet, *M*, alone do not fix the upper segment as firmly as desirable, because the mass of muscles surrounding the humerus slides freely on the bone. Even if the plaster-of-Paris bandage, or some other form of fixed dressing, were used to attach the upper segment to the arm, the same objection and defect would exist. But, with a crutch-head in the axilla,

held in place by a strap around the shoulder, absolute fixation is obtained.

It will be noticed in the description of the apparatus that both the rubber webbing, *W*, and the buckle, *C*, at the end of the lever are pivoted. By this arrangement they adapt themselves automatically to the angle of tension, which is constantly changing, as the forearm segment comes down.

The whole apparatus is much more simple than might be inferred from its description. Nothing could be more simple and uncomplicated than the mechanism which controls the movement of the apparatus. After the tension is applied it does its work automatically. The principle upon which the compound joint is constructed may be utilized in many ways for other joint appliances. Thus, with a slight modification, it may be adapted for overcoming angular flexion of the knee, with outward rotation of the head of the tibia, or in cases of flexion of the hip combined with adduction or abduction of the thigh.



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