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METHOD AND APPARATUS TO INDICATE OR OBSERVE
PROGRESSIVE EXERCISE OF INJURED
SPHINCTER MUSCLES
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Fig. 1

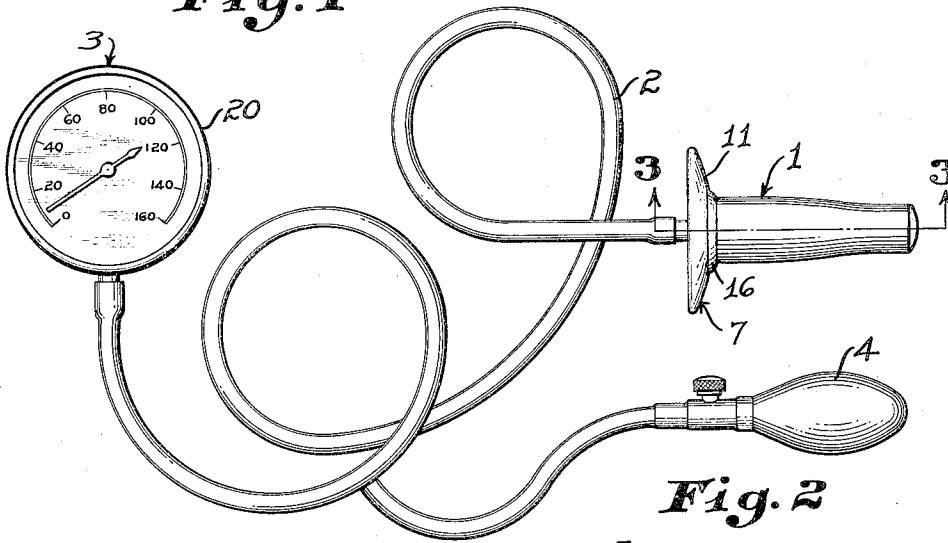


Fig. 2

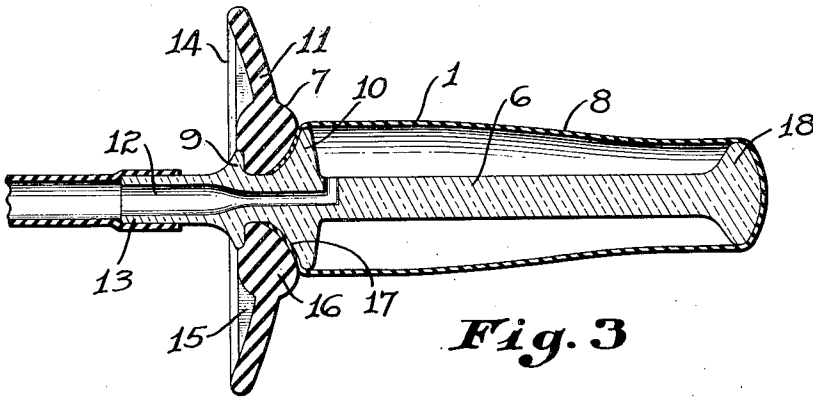
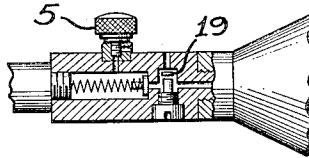


Fig. 3

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METHOD AND APPARATUS TO INDICATE OR
OBSERVE PROGRESSIVE EXERCISE OF IN-
JURED SPHINCTER MUSCLES

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1

This invention relates to a method of and apparatus for indicating or observing indirectly, progressive degrees of exercising injured sphincter muscles for the purpose of developing, reconstruction or regeneration of such muscles. The principle upon which this invention is based is that such muscles as may be injured, torn, or which require development, are (or may be, because of their inherent characteristics, or their anatomical position, or their physiological function, or because of the injury or tearing thereof) difficult or impossible to observe or be cognizant of their function which has, to a degree been lost by such injury so that it is not possible for the individual to exercise the muscles in a manner so that they may be redeveloped or regenerated through use. It frequently is possible in muscles of this character which have been injured for the individual to use or operate the same, but the individual generally has no realization of the fact, or degree of fact, of the use of such muscles so that it is impossible to determine the fact of their utilization or activation.

The regeneration or reconstruction in the development of these muscles is to the greatest degree dependent upon the ability of the individual to use the muscles, to exercise the same and through exercise and use to develop and reconstruct the same.

In accordance with my invention and method it is possible for the individual to determine the fact and degree of use or activation of the muscles by interposing a medium between the muscles and the sight sense which enables the individual to visually determine the fact that the muscles are being utilized and the degree of the use thereof.

The sphincter muscles include an anterior horn motor nerve cell with its axon and terminating in innervating muscle fibres.

In the embryologic development of these muscles it is established that the muscle cell first develops alone and then later receives its nerve supply. Therefore a muscle cell which has lost its innervation through injury or because of inactivation may become reinnervated under certain conditions. These conditions are that in an effort to function or contract there is a physiological demand for muscle cell reinnervation to control such function and, as in the embryologic state, the nerve fibril reaches out to make contact with the injured muscle cell.

In injured muscles the striated muscle fibres with their many nuclei atrophy when they lose their nerve supply but are capable of restoration

2

if they are reinnervated. In these muscles the motor axons are capable of branching to innervate a much larger mass of muscle fibres than is normal.

Fibres of muscles are frequently injured by trauma or use by exercise, bruising, tearing and stretching. The injury often consists of separation of the nerve fibril from the muscle cell but the nerve fibril reconnects quickly upon use of the muscle. If the muscle is not put to use quickly after the injury there is no incentive or necessity for the nerve to reconnect. In the case of all muscular injuries, the problem is to develop an awareness of function, but in many sphincter muscles, particularly where the individual is aware of function rarely and only to a slight degree under normal conditions, the problem of making the individual aware of function is greatly amplified by injury.

It is therefore an object of this invention to produce a method and apparatus for use in making an individual aware of the functioning of sphincter muscles not only as a matter of fact but as a matter of degree so that by functioning such muscles the individual is made cognizant of the fact of the functioning, the degree of the function, and can thereby continue the function of such muscles, by proper exercise during the period that the individual is cognizant of the functioning of said muscles, until they are properly reinnervated so that they may be restored to their normal function, state of development, and so that the nerve fibrils reconnect with the muscle cell.

Another object of this invention is to provide a method which will enable an individual to become aware of the functioning of semi-voluntary and involuntary muscles by providing a yieldable means against which such muscle is operated and which yieldable means is connected with a visual indicator enabling the individual to see that the muscle is functioning and the degree to which the muscle is functioning.

Another object of this invention is to provide an apparatus including a member insertable in a sphincter muscle which comprises a core, a yieldable cover extending over the core against which the muscle is exerted, and a visual or other indicating means associated with the insertable member for indicating the fact and degree of the functioning of such sphincter muscles due to the exertion of the muscular contractive force upon the said yieldable cover.

Another object of this invention is to provide an apparatus for use in the reinnervation and

3

regeneration of sphincter muscles which includes a yieldable element against which the muscular effort is exerted and which yieldable element is of such construction that under the influence of the muscular effort created against it, it does not merely deform in shape to follow the irregularities of the contour of the sphincter muscular cavity, but which provides a sufficient resistant force to enable the muscle to work against it.

Other objects and advantages of this invention it is believed will be apparent from the following detailed description of a preferred embodiment thereof as illustrated in the accompanying drawing.

In the drawings:

Figure 1 is a diagrammatic illustration of an apparatus embodying my invention.

Figure 2 is a fragmental sectional view illustrating a valve means.

Figure 3 is a sectional elevation taken on the line 3—3 of Figure 1.

In the apparatus embodying my invention there is provided an applicator 1 which is suitably connected with a flexible tube 2 to a pump bulb 4. Connected with the tube 2 is a pressure gauge 3. Adjacent the pump 4 is a relief valve 5 which may be opened to release the pressure developed within the system and in the applicator 1.

The applicator 1 is provided with a core 6, a base element 7, and a pliable and flexible rubber or like material elongated, laterally expansible yieldable member or bulb 8 connected between the core 6 and base 7 and surrounding the core 6, as will hereinafter be specifically described.

In Figure 3 I have illustrated the preferred form of construction of the applicator 1 in which the core 6 is formed of spaced flanges 9 and 10 and between which there is positioned concavo-convex disc 11 formed of a flexible material such as vulcanized rubber forming the base element 7. The convex side of this disc faces the end of the applicator over which the flexible bulb 8 is extended. The core 6 is formed with a longitudinally extending passage 12 extending longitudinally of the core from its connecting end 13 to beyond the second flange 10. The concavo-convex disc 11 is provided with a rim 14 which is connected to the base of the disc by means of a plurality of ribs 15 which act to reinforce the concavo-convex disc.

The concavo-convex disc has a thickened inner circular rim 16 which fits between the flanges 9 and 10 so as to clamp the inner free end 17 of the flexible elongated, laterally expansible member 8 against the inner face of the flange 10 to hold the same in position and in fluid-tight relation thereto. The outer end of the core 6 is provided with a head 18 over which the flexible elongated, laterally expansible member 8 is extended so as to prevent injury to the flexible bulb when it is inserted into the sphincter muscle. The novel form of the base element 7, and its relation to the applicator is such that when pressure is exerted on opposite marginal portions thereof, the central portion of the disc moves in an outwardly direction with respect to the marginal portions thereof so as to insure maintaining the applicator in a proper operative position within the sphincter muscle.

As will hereinafter be set forth, the valve 5 includes a check valve 19 permitting the pump 4 when expanded to draw air through the valve section and closing when the pump bulb 4 is compressed so that pressure is developed within the elongated, laterally expansible, yieldable member

4

8. In this connection it is important that the member 8 be of sufficient rigidity as to prevent ballooning of any section of the bulb, that is, of any tendency of the fluid pressure within the member 8 to expand the bulb out of shape with reference to the preformed shape of the elongated, yieldable member. The member must be of such flexibility as to enable the same when inflated to follow the contour of the muscle. The member 8, however, is of sufficient rigidity so that under conditions of operation and inflation it will not "balloon." If "ballooning" is permitted, one section of the muscle might cause the bulb to "balloon" against a weaker section of the muscle, thereby injuring it. If the member 8 is too flexible so that ballooning is permitted of any part of it, it will offer no substantial resistance to the operation of the muscle so that the operation of the muscle against the fluid pressure within the bulb would not be indicated by the gauge 3.

In carrying out the method embodying my invention, the elongated bulb of the applicator is inserted in the sphincter muscle to the point where the base 7 acts as a stop. The pump 4 is operated to inflate the closed elongated, laterally expansible yieldable member 8 to a balanced pressure as indicated by the gauge 3, the pressure to be determined by the strength of the injured muscle which varies from 1 to 30 mm. of mercury or a pressure at which the injured muscle is best able to function. The sphincter muscle is then contracted against the yieldable member 8 and the fact of contraction of the muscle is immediately indicated, if pressure is accurately balanced, by movement of pointer of the gauge 3. At first, in the case of injured muscles where many of the muscle cells have lost their power to contract and awareness of function has been lost, the degree of movement of the said pointer will be very slight. With continued effort, which is guided by oscillations of the pointer, contraction of the muscle will become stronger as will be shown by greater movement of the pointer of the gauge 3, which is the direct result of reinnervation of injured or atrophied muscle cells.

There can be no effort properly exerted unless there is cognizance of effort or awareness of function. Through the use of my method and apparatus it is possible for the individual to have awareness of function and be cognizant of the results which are accomplished through exercising of the sphincter muscles made possible by providing a method and means for indicating the fact of and degree of functioning of the muscles.

It has been established that the actual muscular development, reinnervation and reconstruction which takes place over a period of time proceeds through four distinct phases of operation, which may be defined as an initial phase in which the individual having no awareness of function of the injured muscle gradually attains an ability to actuate the muscle. It is in this period of time that the indicating means provided is of greatest importance in informing the individual of the fact of movement of the muscle through the indicating of the slight pressure fluctuations caused in the air within the flexible member as such pressure fluctuations are indicated upon the dial of the indicator. It is particularly essential in this phase of the reconstruction and reinnervation of the muscles that the pressure within the flexible member be low. A suitable low pressure has been found to be in the neighborhood of 5 to 20 mm. of mercury. The second phase of the

muscular development and reinnervation occurs when the individuals are first able to coordinate their efforts to periodically exert a regular and increasing strength of muscular effort against the flexible element. During the second phase of this operation is found the beginning of the muscle reinnervation. In the third phase, which extends over a period of days, as do each of the phases of muscular reconstruction, the individual has attained muscular control, increased muscular strength, and reinnervation of the muscles is fully attained, and the beginning of the regeneration and reconstruction of the muscular cells occur. This period is observed upon the indicator by the fact that the pressure fluctuations are regular, almost of equal intensity, and correspond with the periods of muscular effort of the individual, and the individual is then able to exert an effort which will be indicated upon the pressure indicator attaining a pressure fluctuation of substantially 40 mm. of mercury. The fourth phase is attained where the individual effort becomes greatly increased in intensity, as will be indicated by the pressure reading of the gauge; in most cases the individual during this phase is able to exert a muscular effort in excess of 80 mm. of mercury, as determined upon the gauge, and the pressure impulses as indicated upon the gauge become extremely regular and in time with and directly controlled by the individual effort. This is the period of complete muscular reconstruction and hypertrophy of the muscular cell followed with loss of fatigue upon effort showing complete recovery of muscular function.

The importance in each of these periods of the indicating means making the individual aware of the function and intensity of effort can not be overemphasized, as it is only through the means of such visual indication of the fact of the effort being produced that the individual is able to obtain control of the effort expended to exercise the muscles and is able to know of the intensity of such effort, the regularity of repetition, all of which is required in order to attain the reinnervation, reconstruction and recovery of control of the muscles.

In some sphincter muscles it is necessary to include a rigid core in the applicator because muscle strands have, due to injury, become disarranged in their anatomical relationships and the core performs the function of enabling such muscles to develop toward their normal position.

The important principle of my invention is that through the use of my method and apparatus the individual is enabled to become aware of the functioning of the muscle, something which has not heretofore been possible through other methods or the use of other devices or apparatus. My invention differs from other types of apparatus which seek to exert a pressure against the muscle or to move or electrically stimulate the muscle independently of the directed effort of the individual. While massaging of muscles may be very useful for many purposes such as stimulation of blood circulation, thereby improving the nourishment to the muscles, there is little comparison between massage and physiological effort to reinnervate and reconstruct muscle tissue. There is nothing which can replace use of a muscle to improve its usefulness. In accordance with my invention the individual becomes aware of the functioning of such semi-voluntary or involuntary muscles and by the individual's own effort of exercising such injured muscles due to the fact that the individual knows when such

muscles are being exercised, the individual is enabled to redevelop these muscles to where they are reconstructed by reconnecting the nerve fibrils with the muscular cells.

In the precise form of the apparatus illustrated in the drawings I have shown the gauge 3 as being formed with an outer case or housing 20 within which the gauge 3 is positioned. The tube 2 is connected with the housing 20 so that the pressure developed in the system is transmitted therethrough. The inlet of the gauge 3 is open to the pressure within the housing.

My method and apparatus is a means by which an individual may apply intelligent effort to aid nature in the regeneration of muscular function following an injury. Following injury it is the path of least resistance of an individual to favor or avoid use of a weakened muscle. When such avoidance of use beyond bare necessity or mere existence continues and becomes a fixed habit, the muscle continues chronically weak. It is the object of my method and apparatus to encourage progressively the use of an injured muscle until it has attained its normal strength and function thereby preventing chronic weakness and disability. In cases in which chronic weakness and disability have occurred and are of long standing, my method and apparatus permits the setting of a standard of function which the individual may attain through constant intelligently directed effort. A muscle with a weak contractile force represented by 5 mm. of mercury of pressure on my apparatus may have a standard of 40 set. By gaining one or more points daily according to my method and apparatus, the standard of 40 may be attained in 40 days or less. The important point is that my apparatus is the means by which the individual becomes cognizant of the fact that the point of additional strength had been gained on any day.

In the case of ordinary skeletal muscle injuries it is not possible to set a standard of accomplishment as a goal except for the provision of a means such as a measuring apparatus which makes the individual aware of the functioning of such muscle. It is the purpose of my method and apparatus to provide not only a means through the medium of which the individual may exercise and strengthen such muscles, but which will at all times permit the individual to be cognizant of the degree of functioning of such muscle or muscles.

Having fully described my invention, it is to be understood that I do not wish to be limited to the details herein set forth, but my invention is of the full scope of the appended claims.

I claim:

1. In apparatus for the development and exercise of the sphincter muscles, an applicator comprising a rigid core having a head at one end, a pair of spaced flanges near its opposed end, a flexible bulb extended over the core from the head end and having its free end portion extending between the flanges, and a concavo-convex disc positioned between said flanges in engagement with said end portion of the bulb for securing the latter in position on the core.

2. In apparatus for the development and exercise of the sphincter muscles, an applicator comprising a rigid core having a head at one end, a pair of spaced flanges near its opposed end, a flexible bulb extended over the core from the head end and having its free end portion extending between the flanges, and a concavo-

convex disc positioned between said flanges.

3. In apparatus for the development and exercise of the sphincter muscles, an applicator comprising an elongated, expansible, hollow member formed of yieldable material, and having a wall of generally frusto-conical form, closed at one end by a rounded portion, the marginal edge of the opposite end merging into a reversibly disposed frusto-conical portion having a central opening therein.

4. In apparatus for the development and exercise of the sphincter muscles, an applicator comprising a rigid core having a head at one end, a pair of spaced flanges near its opposed end, a flexible bulb extended over the core from the head end and having its free end portion extending between the flanges, and a concavo-convex disc formed of relatively flexible material and having a thickened central annular portion snugly fitted between said flanges of the core and embracing said end portion of the bulb.

5. In apparatus for the development and exercise of the sphincter muscles, an applicator comprising a rigid core having a head at one end, a pair of spaced flanges near its opposed end, a flexible bulb extended over the core from the head end and having its free end portion extending between the flanges, and a concavo-convex disc formed of relatively flexible material and having a thickened central annular portion snugly fitted between said flanges of the core and embracing said end portion of the bulb, said disc being positioned with the convex face thereof facing the head end of the core.

6. An apparatus for developing and exercising muscles in a human body comprising a rigid core member, a yieldable member extending over said core member and connected thereto, said core member and said expansible member being adapted to be inserted into a muscular cavity and having an air space of low predetermined pressure within the yieldable member, an indicating means connecting with the air space within the yieldable member for indicating at a point removed from the muscular cavity the degree of pressure changes occasioned by the exertion of muscular

effort against said yieldable member, said yieldable member being formed and connected with said core so that under said low pressure the yieldable member will assume and maintain a shape corresponding substantially to the normal shape of the muscular cavity in which it is inserted without exerting an appreciable pressure upon the walls of said cavity, and said yieldable member being yieldable upon exertion of said muscular contractive force thereagainst to induce a pressure change within the yieldable member, which pressure change is transmitted to the indicating means to make the individual aware of the fact and intensity of muscular contractive effort.

7. In an apparatus of the class described, the combination of an insertable member and an indicating means, the insertable member having a rigid core, a flexible yieldable bulb positioned over the rigid core and having an internal pressure of between 1 to 30 mm. of mercury, said bulb being of such uniform flexibility throughout that ballooning thereof under external pressure application thereto is avoided, means connecting the indicator with the interior of the bulb from the position remote from the bulb so that the indicator is in a position where it may be observed by the operator, the indicator indicating slight pressure changes caused within the bulb by contraction of a muscular force against the bulb whereby the user is made aware of the contraction of such muscle.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,584,464	Maranville	May 11, 1926
1,729,044	Kirk	Sept. 24, 1929

FOREIGN PATENTS

Number	Country	Date
15,864	France	July 24, 1912