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FUNCTIONAL ELECTRICAL STIMULATION VERSUS PULSED MAGNETIC FIELD IN IMPROVING REACHING IN ERB'S PALSIED CHILDREN

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ABSTRACT

Background: the erb's palsied children suffer from reaching problems that interfere with ADL's, **Objective :**The purpose of this study was to investigate the effect of FESversus PEMF on reaching Erb's palsied children. **Methodology**: Thirty Erb's palsied children (14 girls and 16 boys) ranging in age from three to five years participated in this study. They were divided randomly into two groups of equal numbers (Study A and Study B). The Study group A was treated by FES, while the study group B was treated by PEMF. Both groups received the traditional exercise program. Evaluation was carried out for each child individually before and after three months of application, It included 3D analysis. Also every child evaluated by the modified functional scale of reaching to detect the functional improvement of the evaluated reaching task. **Results** revealed significant improvement in most of the measuring variables (p< 0.05) pre and post treatment in both groups with higher percentage of improvement of the study group A. **Conclusion**: improvement in the study group A may be attributed to the effect of FES during the exercise program. So it is considered a beneficial adjunct with the traditional line of treatment in habilitation of reaching function in the Erb's palsied children.

INTRODUCTION

Duchenne and Erb described cases of upper trunk nerve injury, attributing the findings to traction on the upper trunk, now called Duchenne-Erb palsy. In 1885, Klumpke described injury of C8-T1 nerve roots and the nearby stellate ganglion[1]**.**Newborn infants have many findings; the infant with upper BPP (C5-C6) typically lies in the nursery with the arm held at his/her side. Deep tendon reflexes in the affected arm are absent, and the Moro response is asymmetric with no active abduction of the affected arm[2]. Children with intrinsic hand weakness associated with BPP generally have Horner syndrome and vice versa[3]. Neuroplasticity is the ability of neurons to change their function, chemical profile (amount and types of neurotransmitters produced), or structure. It is essential for recovery from damage to the central nervous system[4] . Neuroplasticity is a general term used to encompass the following mechanism: 1-Habituation. 2-Learning and memory (long term potentiation) 3-Cellular recovery from injury[5]. The third mechanism is the more likely to be explained in our research. The regeneration of damaged axons is called sprouting. Sprouting takes two forms: collateral and regenerative.[3] Collateral sprouting occurs when dendrites of neighboring neurons are innervated by branches of intact axons of neighboring neurons. Regenerative sprouting occurs when an axon and its target cell (a neuron, muscle, or gland) have been damaged the injured axon sends out side sprouts to a new target. Functional regeneration of axons occurs most frequently in the peripheral nervous system, Recovery is slow, with approximately 1mm of growth per day, or about 1 inch of recovery per month.[6]

LITERATURE REVIEW

Reaching

[7]define reaching as, one of the fine motor skills of the upper extremity which include movement and stabilization of the arm and hand for the purpose of contacting an object with the hand.[8] added that the reaching movement is a complicated multijoint movement directed to a defined point in space. two distinct and coordinated movement components: The first component is a transportation phase, which brings the hand to the target. In this part of the movement mainly the proximal muscles and joints are involved. The second component is a

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grasp phase, in which the hand is shaped in anticipation of contact with the object. This phase involves mainly the distal joints and muscles. [8]

Peak velocity

[9] revealed that, the peak velocity corresponds to the changeover from the acceleration to the deceleration phase. kinematic parameters such as peak velocity are typically presented as absolute values and/or as normalized values, i.e. expressed as a percentage of the total movement duration. [10], added that, the peak velocity for reaching movements usually occurs before 50 percent of the movement duration.

Pulsed Electromagnetic Field

[11] mentioned that magnet therapy is currently receiving a flurry of interest, based upon writings of physicians, scientists, physical therapists, and other with experience with this modality. The scientific bases for magnet therapy are divided between several theories, all of which agree that "it works". Polarity is only one factor of importance with magnetic field therapies. Research has shown that the negative (South Pole) is primarily sedative, analgesic, and vasodilative. The positive (North Pole) is simulative[12]. [13] Said that Pulsed electromagnetic fields (PEMF) are usually low frequency fields with very specific shape and amplitude. There is significant difference between electric current and PEMF modalities. Electric current stimulation requires skin contact electrodes which may be placed either on both sides of the injury or wound or with one electrode placed over the affected area, the other over normal adjacent tissue. Electrode size, spacing and polarity are the most critical factors in delivering of an adequate stimulating current. [13]

Functional Electrical Stimulation

[14] defined functional electrical stimulation (FES) as, a medical technology using the application of low level electrical impulses to various structures of the body. In rehabilitation, FES is primarily used for activating the neuromuscular system through stimulation of intact lower motor neuron, to initiate contraction of paralyzed muscle to produce functional activities. [15] stated that, FES may be used for purely functional or therapeutic purposes. Functional use implies the activation or enhancement of motion in functional activity as a replacement for lost or impaired motor control. Using the hand master for grasping a cup for drinking is an example of the functional application of FES. [15]added that, a clear distinction needs to be made between therapeutic stimulation and functional stimulation. The former being of an exercise orientation, where one would relax whilst the stimulation work on its own. Functional electrical simulation on the other hand, incorporates this elicited muscles movement into an everyday activity, like standing, walking, reaching out. Electrical stimulation (ES) can be used for the following purposes: To improve the voluntary movement:[16]explained that, electrical stimulation can be incorporated into a variety of therapeutic strategies to enhance voluntary movement and function. The stimulation may act as a sensory cue to encourage recruitment and improve timing of muscle activity. ES may be employed to contract the muscles of interest so the patient can exercise with the stimulation. These activities can be carried into functional tasks such as reaching, standing, shifting weight from one leg to the other, and walking.

Three Dimensional Motion Analysis

[17]reported that many biomechanical (3D) analysis of human movement start with data capture by an imaging device. Still or high speed cameras, video cameras, or optoelectronic systems are the most common of these data capture systems. [18] added that, only objects oriented at right angles to the imaging device will be represented, accurately, in the two dimensions of the image. These two dimensions are usually the vertical and horizontal when the imaging device is aligned to these important real-world directions. [19]stated that, the primary purpose of all such instrumentation is to enable researchers to analyze motion beyond the capabilities of their own physical senses. [20]mentioned that, the three-dimensional analysis systems were originally used in analysis of gait, functional activities and movements of the peripheral joints. They involve attachment of reflective markers to various areas of subject's skin. [21] established that, a complete 3D joint rotation can be determined without hindering the actual motion of the joint, with an accuracy that depends only on the accuracy of spatial reconstruction of the individual markers.[22] mentioned that, there is a great need for using 3D analysis of human movement instead of the older 2D analysis, in order to help us further understands the details of the complicated human movement. [19], stated that, each camera used in a (3D) analysis record marker position in two dimensions only.

Conversion of these data from 2D to 3D data is done by combining data from all cameras mathematically.[23] reported that, active markers require an external energy supply to increase the contrast with respect to background and may be activated stereoscopically to facilitate marker identification.[24] revealed that, three dimensional motion analysis has succeeded to be a useful tool in gait analysis, but for upper extremity, it is still in early stage. Because the variability and complexity of the tasks performed with the upper extremity.[17] reported that, the validity of using 3D video motion analysis to measure hand motion was studied by using three infrared cameras. It showed accurate quantification of digital joint motion. [19] mentioned that, one of the commonly used passive marker motion analysis system is the Qualysissystem which has been used for human as well as animal motion analysis. This system is one of the optical or camera based systems.[25] found that hand prehension functions including reaching and grasping were affected by the initial posture of the hand and arm. This was proved in a study in which 3D kinematics of the fingers and wrists of 13 healthy subjects were measured using Qualysismotion analysis system with 5 mm reflective markers attached to distal portion of the thumbnail, on the distal portion of the index finger, and on the ulnar process of the wrist of the right hand.

SUBJECTS, MATERIALS AND PROCEDURES

Subjects

Thirty spastic hemiplegic cerebral palsied children from both sexes participated in this study from out patient clinic of faculty of physical, Cairo University. They were classified randomly into two groups group (A) study included 15 patients received traditional physiotherapy program in addition to pulsed electro magnetic field (B) study included 15 patients received same program of control in addition the functional electrical stimulation.

MATERIAL

First: For evaluations:

1. Modified functional scale for reaching (Pratt Allen, 1989)
2. Qualysis medical AB system Pro reflex camera:

Second: for treatment traditional physical therapy equipment like balls, rolls, wedges and motivational targets, electrical stimulator containing a faradic current.

METHODS

For evaluation

Using qualysis medical AB system

1. Camera placement: three cameras used in capturing the childe's motion arranged around the child.
2. Calibration: the system was calibrated before capture.
3. Capturing: after calibration was saved the capture or the measurement phase was started by new capture.
4. Kluzik *et al*., (1990)., Volman *et al* ., and Aly, (2004)

Fig (1) FES

Fig(2) PEMF

By using modified functional scale of reaching:

Each child was also evaluated using a modified functional scale for reaching.

Therapeutic procedures for the study (A) traditional physical therapy program in addition to pulsed electromagnetic field:

Therapeutic procedure

1st : functional electrical stimulation Study group(A)

1st channel to stimulate the shoulder flexion and elbow extension,
2nd channel to stimulate the wrist extention.

Frequency was 20 pps
Pulse width was 300 msec
Duty cycle (on \ off)
Shape of wave Rectangular
Amplitude according to patient tolerance treatment was conducted three times per week

2nd Pulsed Electromagnetic field

For the study group (B)

Children in this group received pulsed magnetic field, in the form of pulsed stimulation waves which was applied on Erb's point, in addition to the traditional exercise therapy program.

RESULTS

Movement time

Table (1) comparison between pre treatment mean values of the movement (ms) for both study A and Study B groups

Item		X̄±SD	MD	T value	P value	significance
Movement time (ms)	Study A Study B Study B	1405.07±433.8 1402.6±441.31	-2.47	0.015	0.988	NS

Table 2 Comparison between movement time pre and post treatment mean values of movement time (ms) in study group B

Item		X±SD	MD	T value	P value	significance
Movement time (ms)	Pre Post	1402.6±441.31 1361.93±435.1	40.67	1.87	0.082	NS

Table 3 as identified in the differences between the pre and post treatment mean values ±SD of movement time for study A

Item		X̄±SD	MD	T value	P value	significance
Movement time (ms)	Pre Post	1405.07±433.8 1055.93±298.11	349.14	6.19	<0.0001	HS

Table 4 it's evident that the difference between the control and study groups in their post treatment mean values

Item		X±SD	T value	P Value	significance
Movement time (ms)	Study B Study A	1361.93±435.1 1055.93±298.11	2.25	0.033	S

Peak velocity

Table 5 comparison between the study A and Study B in their pre treatment mean values of the peak velocity (cm/ sec)

Item		X±SD	MD	T value	P value	significance
Peak velocity (cm/ sec)	Study A Study B	49.07±19.51 47.53±18.03	-1.54	0.224	0.825	NS

Table 6 comparison between the pre and post treatment mean values of the peak velocity (cm /sec) in the Study B:

Item		X±SD	MD	T value	P value	significance
Peak velocity (cm/ sec)	Pre Post	47.53±18.03 47.13±16.1	0.4	0.45	0.689	NS

Table 7 comparison between the pre and post treatment mean values of peak velocity (cm / sec) in Study A:

Item		X±SD	MD	T value	P value	significance
Peak velocity (cm/ sec)	Pre Post	49.07±19.51 47.6±17.72	1.47	0.65	0.527	NS

Table (8) comparison between the Study B and A groups in their post treatment mean values of peak velocity (cm/ sec)

Item		X±SD	T value	P value	significance
Peak velocity (cm/ sec)	Study B Study A	47.13±16.1 47.6±17.72	0.41	0.688	NS

Grades of modified functional scale of reaching

Table (9) comparison between the study A and study B groups in their pre treatment mean values of grades of modified functional scale of reaching

Item	X±SD	MD	T value	P value	significance
Study A Study B	1.6±0.51 1.4±0.51	-0.2	1.08	0.281	NS

Table 10 comparison between the pre and post treatment mean values of grades of modified functional scale of reaching in the study B

Item	X±SD	MD	Z*value	P value	significance
Pre Post	1.4±0.51 1.6±0.63	-0.2	1.08	0.046	S

Table 11comparison between the pre and post treatment mean of grades of modified functional scale of reaching in the study group A

Item	X±SD	MD	T value	P value	Significance
Pre Post	1.6±0.51 2.53±0.52	-0.93	3.54	0.000	HS

Table (12) Comparison between the Study B and Study A in their post treatment

Item	X±SD	Z*value	P value	significance
Study B Study A	1.6±0.63 2.53±0.52	3.44	0.001	HS

DISCUSSION

The results of this study showed that, the use of functional electrical stimulation (FES) combined with traditional physical therapy program for reaching, is relatively an effective method for treating children with erb's palsy. The efficacy of combined treatment method was confirmed by the clear improvement observed in some kinematic parameters of reaching and in reaching performance. In most previous studies, the electrical stimulation has been used successfully in the treatment of lower extremity weakness in lower motor neuron lesion patients [26] **.** The pre treatment mean values of the present study in both Study B and study group A showed non significant difference statistical difference (p > 0.05) in all the measuring variables, as shown in tables (1,5,9). These findings clearly demonstrate the homogeneity between both groups before starting the study reflecting the validity of the sample collection and random classification of children between both groups. On the other hand Pre treatment results indicated that, all children demonstrated considerable difficulties in reaching abilities which demonstrated by disturbed kinematic parameters prolonged movement time, low peak velocity and decreased reaching performance. These findings come in agreement with[27]who used reaching trajectories in normally developed children, when studying children with motor impairments. The results showed that, movement time was longer in the children with motor impairment. These results also were concomitant with the studies done by [9]who found that, reaching inerb's palsy, where movement duration, peak velocity, average velocity and the time at which peak velocity occurred in the movement were significantly more variable than their values in normal subjects. This also agreed with [10]who confirmed that, movement of the affected arm of erb's palsied child is characterized by decrease in movement speed, smoothness and increased asymmetry in velocity profile compared with the non affected arm. The pre treatment mean values of movement time for both study B and study group A were 1402.6±441.31 (ms) and 1405.07±433.8 (ms) respectively, these findings revealed prolonged movement. These findings may be attributed to difficulties in movement initiation due to the muscle weakness and loss of synchronization of joint movement. This come in agreement with [28,29]*Levin et al., (1993 and 1996)*, who studied reach and grasp timing problems and found that, delayed movement times attributed to disruptions of inter joint co-ordination between the upper extremity joints. The deference between the study B and study A groups in their post treatment mean values of movement time was significant (P= 0.033). The mean values of the movement time for the Study B and study group A were 1361.93±435.1 (ms) and 1055.93±298.11 (ms) respectively. The percentage of improvement of movement time post treatment was 22.47% with respect to study group A. These results may be attributed to combined effect of FES and designed exercise program which facilitates the initiation of movement by stimulating the weak muscle and enhancing the motor unit recruitment. These results agree with [16]who stated that FES can be incorporated into a variety of therapeutic strategies to enhance voluntary movement time and function. The stimulation may act as a sensory cue to encourage recruitment and improve timing of muscle activity. In spite of the significance decrease in movement time (MT) in study group A which revealed an improvement after treatment, it still longer than those reported by[27], for reaching tasks performed by healthy 1.5 to 8 years old children. The pre treatment means values for Study B and study group A were 47.53±18.03 (cm/sec) and 49.07±19.51 (cm/sec) respectively which revealed lower peak velocity than normal subjects. These results come in agreement with [8]who stated that, increased peak velocity is associated with greater force generation.[30] explained the decreased peak velocity by the presence of timing problems in children with erb's palsy, these problems comes from the impairment in synchronization of movement which manifest as inability to appropriately time the activation of muscles and thus the movement itself. These timing problems are reflected on the velocity of upper limb motions. As shown in table (6), the mean values of the peak velocity for the study B and study A groups post treatment were 47.13±16.1 (cm/ sec) and 47.6±17.72 (cm/sec) respectively. The percentage of improvement was -0.47% which revealed non significant difference (p= 0.688). These results may be attributed to that; the clumsy children have to slow down movement speed to achieve movement accuracy. These findings come in agreement with [31]who found that, slowing down the movements in erb's palsied children would allow more time to use visual and kinesthetic feedback . It has been suggested that if a goal-directed movement is well learned and controlled, the PPV tends to be near 50% or larger.

Thus, PPV reflects the control of reaching [10]**.**From the previous results it could be concluded that, the erb's palsied children in the present study exhibited prolonged deceleration phase this may be attributed to decreased organization and planning of movement and motor control. These results also confirms the findings of [8]who found that, when compared to normal performance, the erb'splasy revealed a lower percentage of reach where peak velocity occurs, that is, prolonged deceleration time, which might stem from loss of force control and need more feedback for correcting the ongoing movement. This also agree with [10]who stated that according to a motor programmed approach of movement control, a right shift of location of peak velocity indicates that reaching movements are more preplanned as it was clear in the post treatment results of the study group.

The finding that movement time decreased and location of peak velocity shifted to the right, together with a relatively unchanged peak velocity post treatment in study group A indicates the reaching performance was enhanced particularly in the deceleration phase [10]The pre treatment mean values ± SD of grades of modified functional scale for reaching for both study B and study A groups were 1.4±0.51 and 1.6±0.51 respectively, which reflect decreased reaching performance when compared by the post treatment values. These results may be attributed to the neurological defects of the Erb's palsied children which include weakness, muscle tightness, in coordination, defective motor control. These results agree with [32]who stated that delay in the acquisition of gross and fine motor function is indicated by cerebral palsied children; this delay may produce functional limitations and disturbance in social functioning. The post treatment mean values of the grades of modified functional scale of reaching for the Study B and study A groups as indicated in table (12) were 1.6±0.63 and 2.53±0.52 respectively. The percentage of improvement was -58.12% which were highly significant(P= 0.001) in favor of study group A. The highly significant improvement that occurred in the study group A may be attributed to the effect of FES in recruiting more motor units within the stimulated muscles than by voluntary contraction alone. This comes in agreement with [33]who confirmed that the use of electrical stimulation could be a valuable complement to the normal training of the arm of the erb's palsied patient in increasing motor function significantly. This finding is also in agreement with [34]who reported that improvements in performance occur as a result of practice for instance, appropriate sequencing of movement components, reduced effort and concentration, improved timing and speed control. These results also agree with[35] who found that the NDT can improve the functional performance and the EMG profile in the affected upper extremity.

References

1. Al-Qattan, M.M. (2003).Obstetric brachial plexus palsy associated with breech delivery. Annals of Plastic Surgery; 51: 257-264.
2. Millesi H (2000). Techniques for nerve grafting. Hand Clin; 16:73-91.
3. Balakrishnan G and Kadadi B. (2004) Clinical examination versus routine and paraspinalelectromyographic studies in predicting the site of lesion in brachial plexus injury. J Hand Surg [Am]; 29:140-3.
4. Johanson, B (2000): Brain plasticity and stroke rehabilitation. Stroke, 31, 223-230.
5. Marsden, C. (1998): Pediatric Neurology, In: Marsden, C. D. and Fowler, T. J. (Eds.) Clinical Neurology, 2nd ed. Mobsy, London, PP.: 340-366.
6. Kastin, J and Pan, W (2005): Targeting neurite growth inhibitors to induce CNS regeneration. Current Pharmaceutical Design, 11(10), 1247-1253.
7. Exner CE. (2001). Remediation of hand skill problems in children. In: A., Handerson and C., Pehoski (Eds), Hand function in the child foundations for remediation, st. Louis: Mosby, PP: 197 -222.
8. Ching WU., Catherine A., Trombly ScD., *et al*. (2000). A Kinematic study of contextual effects on reaching performance in persons with and without stroke: Influences of object availability Arch Phys Med Rehabil Vol 81, January.
9. Van Vliet P., Kerwin DG., Sheridan M., and Fentem P. (1995). The influence of goals on kinematics of reaching following stroke. Neurol. Rep. 19 (1), 11-16.
10. Volman JM., Wijnroks A., and Vermeer A. (2002). Effect of task context on reaching performance in children with lower motor neuron weakness. Clinical Rehabilitation. 16: 684-692.
11. Kahn J (2000): The Basic of Electrical Stimulation. Whirlpool, Fall, p.26.
12. Bricknell, R and Watson, T. (1995): the stimulatory effect of pulsed magnetic field therapy. Br J ther Rehabil, 2,430-434.
13. Marko S. and Agata, P (2001): Magnetic and Electromagnetic Field Therapy, EMF therapeutics, Chattanooga, USA. *Journal of Back and Musculoskeletal Rehabilitation* (15) 17-29.

14. Low j., Reed A., and Dyson M. (2000). Electrotherapy explained principles and practice (3rd ed), Butterworth Heinemann. PP 83-84.
15. Kimberley TJ., Lewis SM., Auerbach EJ. (2003). Electrical stimulation driving functional improvements in subjects with peripheral nerve lesion 2003 Nov 15.
16. Chae J., Bethoux F., Bohinc T., Dobos L ., Davis T., and Friedl A. (1998). Neuromuscular Stimulation for Upper Extremity Motor and Functional Recovery in Acute Erb's palsy; 29: 975-979.
17. Allard P., Strokes IF., and Blanchi JP. (1995). Three-dimensional analysis of human movement. Human kinetics, PP; 19-77.
18. Kudson D., and Morrison C. (2002). Qualitative Analysis of Human Movement (2uctedltlOn). Human Kinetics, USA S; PP: 199-204.
19. Hamilton N., and Luttgens K. (2002). Instrumentation for motion analysis in: kinesiology scientific basis of human motion (Othed. McGraw Hill, PP538-552.
20. Cheze L. (2000). Comparison of Different Calculations of Three-Dimensional Joint Kinematics from Video-Based System Data. J. Biomechanics. 33: 1695-1699.
21. Crisco JJ., Chen X., Panjabi MM., and Wolfe SW. (1994). Optimal Marker Placement for Calculating the Instantaneous Center of Rotation. J. Biomech. 27(9): 1183-1187.
22. Jordan K., Dziedzi CK., Jones P., Ong B., and Dawes P. (2000). The reliability of three dimensional fast track measurement system in measuring cervical spine and shoulder range of motion in healthy subjects. Rheumatology. 39: 382-338.
23. Perry J. (1992). Gait Analysis, Normal and Pathological Functions. Slack incorporated, 6900 Grove Road, NJ. PP: 358-378.
24. Rau GC., Klug D., and Schinidt R. (2003). Movement biomechanics goes upwards: from the leg to the arm. *journal of biomechanics* (33):1207-1216.
25. Kritikos A., Jackson G., and Jackson S. (1998). The influence of initial hand posture on the expression of prehension parameters. Exp Brain Re. 119:9-16.
26. Tung T, and Mackinon S, (2003): Brachial plexus injuries. Functional electriclastimulation Clin Plast Surg; 30(2): 269-87.
27. Kluzik J., Fetter L., and Coryell M. (1990). Quantification of control: a preliminary study of the effect of neurodevelopment treatment on reaching in children with spastic cerebral palsy. Phys Ther; 2:65 -78.
28. Levin MF., Horowitz M., and Jurrius C., *et al*., (1993). Trajectory formation and interjiont co- ordination of drawing movements in normal and hemiparetic subjects. Neuro SciAbstr; 19: 990.
29. Levin MF. (1996). Inter joint co-ordination during pointing movements in disturbed in Erb's palsied. Brain; 119: 281-293.
30. Ramos, L.E. and Zell, J.P. (2000). Rehabilitation program for children with brachial plexus and peripheral nerve injury. Semin Pediatr Neurol; 7(1): 52-7.
31. Durward B., Bear G., and Rowe. (2001). Functional human movement: measurement and analysis. Butter Worth Heinemann. Oxford. PP: 148-158.
32. Lepage C., Noreau L., and Bernard PM. (1998): Association between characteristics of locomotion and accomplishment in Erb's palsy Phys. Ther. 78(5): 458-469.
33. Alex C., Alain B., Daniel U., and Gerald G.(1999). Shoulder pain and dysfunction in upper limb nerve lesion. Effects of functional electrical stimulation. Ach Phys Med Rehabil Vol 80, March.
34. O'Sullivan S. (1994). Parkingson’s disease: Physical rehabilitation. In: O'Sullivan S., Schmitz T. Physical rehabilitation assessment and treatment. (2nd ed). Philadelphia: FA Davis, 481 – 493.
35. Marcus, J. and Clarke, H. (2003): Management of obstetrical brachial plexus palsies evaluation, prognosis and primary surgical treatment reaching evaluation and treatment. Clinics in Plastic Surgery; 30: 289-306.

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