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Evaluation of Functional Recovery and Pain Progress in Patients Subjected to Total Knee Replacement Surgery and Subsequent Electroanalgesia Cycles

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Introduction

Over recent years, there has been a considerable increase in the number of total knee replacements, due not just to the rise in the average age of the population, and thus to the degenerative illnesses that characterize the elderly, but also to the increased sophistication of surgical methods.

The level of post-op knee replacement patient satisfaction is essentially linked to the regression of the painful symptoms and the functional recovery of the joint, which entail the patient's return to autonomy of movement and everyday activities. However, the data produced by this study supports the fact that it is common for a high percentage of patients on rehabilitation wards to fail to obtain the desired results in the short-medium term following knee replacement surgery. In comparison, the percentage of patients satisfied in the short term following hip replacement surgery is far higher.

The scope of this study was to analyze the relationship between progress in the replaced knee functionality and the painful symptoms experienced by patients subjected to specific rehabilitation treatment, in association with analgetic physical therapy with Horizontal Therapy or TENS. Horizontal Therapy (HT) is a type of electroanalgesia that is part of a new generation of electric medical devices that make it possible to bioelectrically and biochemically stimulate cells and cellular issue at the same time, on both a surface level and deep down.

Materials and Methods

Sixty-two subjects were selected with an average age of 69.9 (minimum 60 – maximum 75), 40 of whom were female and 22 male, all of whom had undergone total knee replacement surgery due to gonarthrosis.

Each patient underwent an isokinetic knee flexion and extension examination at three and four months after surgery, using the Cybex 6000 appliance. This examination involved flexing and extending the knee 5 times at an angular velocity of 60°/second, followed by an endurance test that involved flexing and extending the knee 30 times at 120°/second. The patient was asked to complete the arch of movement from 0° to 90° while seated on the isokinetic appliance, and flex and extend the knee at the two selected angular velocities with as much strength as possible. The test was carried out on the unoperated side first, and then, after a 5-minute rest, on the operated side. The parameter taken into consideration was the strength of the extensor and flexor muscles (Torque in Nm). Three months after the operation, the patients underwent 15 antalgic electrotherapy sessions (TENS or Horizontal Therapy, selected at random), associated with motor re-education consisting of 30-minute muscular strengthening, proprioceptive exercise, and assisted walking sessions. Moreover, at three and four months after the operation, the patients were asked to fill in a form regarding their level of post-op satisfaction in keeping with the IKS (International Knee Society Rating System), associated with VAS pain evaluation scale.

Results

The data obtained from the first examination three months after the operation demonstrates a considerable decrease in the strength of the knee's flexor and extensor muscles, in comparison with the values obtained by the contralateral limb (unoperated).

At four months from the operation, hyposthenia persists in some muscular regions (although a significant sthenic increase is evident with respect to the examination carried out a month earlier), as does the imbalance in the flexor/extensor ratio compared to the unoperated, contralateral limb.

Unoperated side

Torque(Nm)	60 degrees/second		120 degrees/second	
	3 months	4 months	3 months	4 months
Extensors	133±12	148±22	120±17	129±15
Flexors	82±10	91±14	76±11	79±16

Operated side, treatment with TENS (30 patients)

Torque(Nm)	60 degrees/second		120 degrees/second	
	3 months	4 months	3 months	4 months
Extensors	39±13	96±15*	19±8	69±8
Flexors	49±11	67±13	37±9	55±12

Operated side, treatment with Horizontal Therapy (32 patients)

Torque(Nm)	60 degrees/second		120 degrees/second	
	3 months	4 months	3 months	4 months
Extensors	36±9	118±19*	22±8	87±10
Flexors	45±14	77±10	34±9	63±8

Significant for $p<0.05$.

The most significant facts that emerged from the analysis of the results are as follows:

1) With regard to the recovery of the strength of the quadriceps and the ischiotibial elements, evaluated using the isokinetic method, which provides an indication of the strengthening techniques implemented as part of the rehabilitation cycle in the three months following the operation and, indirectly, the reduction in the intensity of pain felt in the knee, a clear improvement in torque is observed in the test at 60° and that at 20°/second. This improvement is statistically significant in the group treated with HT, unlike the group treated with TENS. We also observed an increase in strength in the unoperated side during the examination at four months, compared to that at three months. This is indicative of improvements in the patient's overall autonomy - as the patient is able to move about more and better, he/she acquires greater strength in the muscular groups not directly subjected to treatment.
2) The variation in pain observed during the examination at four months, compared to that at three months from the operation (and thus after the execution of the combined analgesic/reductive cycle), was evaluated using the qualitative type data derived from the IKS (International Knee Society Rating System) scale and the quantitative type data obtained from the VAS scale (Visual Analog Scale). With regard to the IKS scale, the most significant data is represented by the reduction in the “continuous pain” category from 32% (20 cases out of 62) to 28% (8 cases out of 30) in the group treated with TENS, and to 12% (4 cases out of 32) in the group treated with HT, and the reduction of the “walking for under 500 meters" category from 40% (25 cases out of 62) to 28% (8 cases out of 30) in the group treated with TENS and to 12% (4 cases out of 32) in the group treated with HT. This data seems to suggest that Horizontal Therapy is more effective than TENS in controlling knee replacement post-op pain. A similar consideration can be made based on the quantitative VAS data, which shows average % values of 36 before treatment, which fall to 25.4 after treatment with TENS and to 12.4 after treatment with HT.

Discussion and Conclusions

The level of post-op knee replacement patient satisfaction is essentially linked to the regression of the painful symptoms and the functional recovery of the joint, which entail the patient's return to autonomy of movement and everyday activities. However, the data produced by this study supports the fact that it is common for a high percentage of patients on rehabilitation wards to fail to obtain the desired results in the short-medium term following knee replacement surgery. In comparison, the percentage of patients satisfied in the short term following hip replacement surgery is far higher. In particular, of the 62 subjects we examined three months after the operation, 23 (37%) still complained of continuous knee pain, 27 (43%) experienced frequent pain when placing weight on their knee, and just 12 (20%) did not have any problems of which to complain, declaring themselves to be fully satisfied with the outcome of the operation. Various causes could be suggested in order to explain the problems in achieving rapid improvement after this type of operation. The first factor to be analyzed is the persistence of knee pain that, as indicated above, afflicts a very high percentage of patients. In addition to causing significant worsening in quality of life, the persistent pain has a negative effect on the recovery of strength in the femoral quadriceps (due to the inhibition induced by the pain during contraction exercises against resistance), and on the improvement of the proprioceptive afferent legacy, which is indispensable for ensuring adequate control of joint movements. With regard to the latter aspect, it is interesting to refer to the study carried out by Matre, which demonstrates how a pain stimulus, induced in the joint for experimental purposes, produces a significant reduction in the perception of the joint movement. The battle against pain thus assumes values that go over and beyond the primary scope of ensuring patient well being, taking on particular significance in terms of influencing other factors of primary importance such as muscular recovery and proprioceptive sensitivity. Greater attention should therefore be dedicated to the development of analgetic operations during the post-op period.

The possible options probably include resorting to pharmacological treatment that is more effective, even using opiate-type analgesics in certain cases, although they are still not readily available in our country (unlike other European countries) for uses outside the field of oncology. The possible presence of neuropathic pain, which overrides the nociceptive pain, should also be considered. In fact, it should not be forgotten that knee replacement operations are mainly carried out on patients who have experienced prolonged periods of joint pain. In this situation, experimental studies have documented the possible transition from inflammatory joint pain to neuropathic pain, sustained by histochemical modifications on the level of the spinal neuronal circuits. Based on the above, the systematic search for neuropathic characteristics in knee replacement post-op pain and the consequent introduction of antineuropathic drugs into the analgesic treatment regimes could prove to be evaluative/therapeutic approaches able to boost rehabilitation and accelerate functional recovery.

In patients still suffering from significant functional problems three months after TKR surgery, associated with persistent knee pain, the use of electroanalgesic techniques associated with a repeat of the rehabilitation cycle seems to guarantee an improvement that, according to our findings, is more effective with the use of Horizontal Therapy than TENS.

Another factor able to have a negative influence on a rapid functional recovery, and thus create a state of dissatisfaction in the patient during the post-operative period, is represented by the difficulty in recovering strength in the femoral quadriceps muscle, which is fundamental to the articular mechanics of the lower limb and correct walking and posture. Hypotrophy and hyposthenia from non-use, as a result of prolonged periods of hypomobility or

immobility prior to surgery, are associated with frequent problems in voluntary muscular contraction determined by the chronic pain produced by a persistent lack of strength in the quadriceps. Post-op rehabilitation programs should probably include methods such as stimulation electrotherapy (especially with regard to safeguarding the type I fibers, which are most subject to damage caused by hypomobility) and electromyographic biofeedback, on a more systematic and more frequent basis than found in current protocols.
A third element able to significantly affect functional recovery after knee replacement surgery is represented by the qualitative and quantitative deficit of proprioceptive afferents from the lower limb, which are indispensable to guaranteeing effective control over movement and the prevention of incongruous movements. After knee replacement surgery, the perception of joint movement transmitted by the quick-adapting receptors is reduced, while the perception of the joint position channeled by slow-adapting receptors does not appear to change. From an evaluative point of view, this situation poses some problems that have not yet been resolved in clinical practice, since the simplest, most easily repeatable tests regard the evaluation of the joint position but are difficult to relate to those that study joint movement. There is therefore a shortcoming in the possibility to objectify proprioceptive deficits in knee replacement patients, which results in a possible tendency to attribute little importance, in rehabilitation programs, to methods specifically designed to improve the proprioceptive afferent heritage.

To briefly sum up the above considerations, we can state that:

1) In the short/medium term following total knee replacement surgery, a high percentage of subjects are dissatisfied
2) In evaluative terms, this dissatisfaction is subjectively evident in persistent knee pain and difficulty walking and can be instrumentally documented using isokinetic assessment methods, which demonstrate the persistence of the lack of strength in the quadriceps and ischiotibial elements.
3) It consequently seems opportune to introduce some of the following changes and additions to commonly adopted rehabilitation programs, which could prove to be particularly important:
    a) greater control of painful symptoms during the intensive post-op rehabilitation period, introducing analgesic regimes that are more effective, and assessing the possibility of using antineuropathic drugs in the case of documented need;
    b) the acceleration of quadricipital muscular recovery through the systematic use of muscular stimulation electrotherapy and, in selected cases, electromyographic biofeedback;
    c) the improvement of a correct proprioceptive afferent legacy with the standardized use of cognitive re-education techniques and the use of proprioceptive biofeedback methods;
    d) the standardized introduction of a second rehabilitation cycle, associated with electroanalgesic techniques, especially Horizontal Therapy, during the diagnosis and treatment of patients subjected to TKR surgery with persistent pain and functional deficits three months after the operation.

The effectiveness of these changes in obtaining the objectives set in the individual rehabilitation project should obviously be checked in future controlled clinical studies, during which it would be opportune to compare the results obtained from further additional differentiated operation programs.

Summary

The scope of this study was to analyze the relationship between progress in the replaced knee functionality and the painful symptoms experienced by patients recovering from total knee replacement surgery, subjected to specific rehabilitation treatment, in association with analgetic physical therapy with Horizontal Therapy or TENS. Horizontal Therapy (HT) is a type of electroanalgesia that is part of a new generation of electric medical devices that make it possible to bioelectrically and biochemically stimulate cells and cellular tissue at the same time, on both a surface level and deep down.

Materials and Methods. Sixty-two subjects were selected with an average age of 69.9 (minimum 60 – maximum 75), 40 of whom were female and 15 male, all of whom had undergone total knee replacement surgery due to gonarthrosis.

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Results. By comparing the values of the operated limb with those of the contralateral limb, the initial analyses show a macroscopic decrease in the strength of the knee flexor and extensor muscles, especially the former, which is most marked at three months after the operation. At four months from the operation, hyposthenia persisted in these muscles, although with a considerable increase in strength compared to six months earlier. Moreover, the imbalance in the flexor/extensor ratio compared to the unoperated, contralateral limb also persisted.

With regard to the painful symptoms in the 62 subjects we examined three months after the operation, 23 (37%) still complained of continuous knee pain, 27 (43%) experienced frequent pain when placing weight on their knee, and just 12 (20%) did not have any problems of which to complain, declaring themselves to be fully satisfied with the outcome of the operation.

The variation in pain observed during the examination four months after the operation, compared to that at three months after the operation (and thus after the execution of the combined analgesic and re-education cycle) was evaluated using the qualitative type data derived from the IKS (International Knee Society Rating System) scale and the quantitative data obtained from the VAS (Visual Analog Scale). With regard to the IKS scale, the most significant data is represented by the reduction in the “continuous pain” category from 32% (20 cases out of 62) to 28% (8 cases out of 30) in the group treated with TENS, and to 12% (4 cases out of 32) in the group treated with HT, and the reduction of the “walking for under 500 meters" category from 40% (25 cases out of 62) to 28% (8 cases out of 30) in the group treated with TENS and to 12% (4 cases out of 32) in the group

treated with HT. This data seems to suggest that Horizontal Therapy is more effective than TENS in controlling knee replacement post-op pain. A similar consideration can be made based on the quantitative VAS data, which demonstrate average % values of 36 before treatment, which fall to 25.4 after treatment with TENS and 12.4 after treatment with HT.

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