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IMPRO-VEMENT in CARE

Meeting the needs of private practice physiotherapists…

Although theoretically, the Physiotherapists' and Massage therapists' practice is vast and varied, in reality the majority of requests concern treatment of functional disorders, and in particular, those affecting the musculo-skeletal area. To satisfy this need, physiotherapists use many techniques and tools which have advantages, I.e. they enable the physiotherapist to meet objectives of rehabilitation and deal with disadvantages which may concern the time necessary for application of the professional procedures, but also in intensity and repetition which are the cause of practitioner's fatigue. To help practitioners, it was necessary to design a machine which:

- Respects human physiology,
- Accompanies functional movements,
- Adapts to a variety of situations of rehabilitation,
- Accompanies the patient indicating to him/her biofeedback of his/her efforts,
- Accompanies and controls dynamic movements,
- Makes it easy to visual and store results.
- Is fast in terms of adjustments, easy to use and is financially appropriate to the sector of activity.

Which respects human physiology :

Movements in daily life are not solely sagittal nor solely lateral/frontal, nor solely transversal/rotational, but are the exceptional result of a combination of the three in order to carry out more or less complex procedures. These procedures can range up to produce circumvolutions or of 8 in 3D, in other words, movements without restriction to a single plane. Activities of everyday life are the visible translation of all possible combinations (bringing a fork to one's mouth, combing one's hairs, executing a task on a production line at work, shooting into a balloon, playing tennis, etc.). Physiological joint movements are never uniform and in a single plane[1], it is essential to comply with this physiological basis in rehabilitation. Currently, equipment made available to the physiotherapist and his/her patient generally are designed to make the joint work in one plane (some exercises provide measurements, such as for example, isokinetic equipment), while others give a workout in several planes, but do not provide or provide few measurements of movements (elastic, pulley therapy, platforms, etc.).

A new generation of equipment now makes it possible to perform analytical, as well a functional workout with control of movement and measurement of effort. Therefore, it is possible to follow movements as they are based on the physiological construction of joints, and the physiotherapist can programme the equipment perfectly without imposing a movement which is physiological. Therefore, during use of this equipment, movements of the human body as they have been designed at the start by anatomical functioning are complied with, particularly in the spatial dimension (amplitudes and orientation in 3D).

With these new generations of equipment, designed for 3-dimensional, functional workout, the number of configurations in 3D is infinite. From a practical standpoint, the use and placement are facilitated: the physiotherapist installs his/her patient according to the movement that he/she wishes to make him/her execute and has only to adjust on the equipment the workspace in which he/she wishes the movement be executed.

Who accompanies functional movement :

Motor equipment specific to each individual concerns the rational aspect of the gesture and falls within the scope of daily activities related to relational, familial, occupational, athletic, culture and leisure life. These activities involve the use of several joints and muscle actions. Therefore, it involves taking into account the impact of a deficiency on the main functions of the locomotor system, implicating notions of potential of activity, autonomy, reinsertion and psycho-social aspects[2].

With this type of equipment, the movement executed by the patient can incorporate not only a spatial situation, involving a single joint, but also an association of movements involving the proximal or distal joints. This then is the sum total of segments which produce a movement in a system of sequenced synergistic actions which involve joint units, as well as muscle units.

Another characteristic of functional movement as performed and experienced in everyday life is that the functional

aspect is only very rarely solely concentric or static. It is primarily eccentric, at variable speed that the equipment must control and intensities that are also adjustable. In daily practice, the physiotherapist chooses the type of muscle workout based on the muscle specificity concerned “taking into account that the disorder prohibits or prevents certain muscle activities. The type of workout chosen should not be limited to a single possibility when several of them can be performed. It is necessary to give back to the muscle all of its properties”[2].

To take into account these aspects in rehabilitation of the patient, physiotherapists have long preferred to use their hands instead of machines. Guiding and accompanying the patient’s gesture in one plane or in 3D, the physiotherapist would provide resistance himself by adapting it to the patient’s efforts and to his capacities. This new generation of equipment has aided the physiotherapist in his/her practice by offering the possibility of executing a movement in three dimensions, which complies with human physiology by offering variable types of exercises regarding their mode of muscle work (taking into consideration functional requirements of the muscle in its specificity) and taking into account other functional components such as speed. The patient[3] can work on variable movements, such as a gesture, starting with the arm of the upper limb, projection of the lower limb, a hand to mouth movement, Kabat’s diagonal movements etc.

Who adjusts to the variety of rehabilitation situations :

In physical rehabilitation, the physiotherapist is confronted with a quest for mobility, amplitude and muscle action and of speed. For each of these requirements, and depending of stage of rehabilitation, this new generation of equipment differs from other equipment by its polyvalent aspect[4] and it has possibilities for easy adjustment: a certain number of parameters are available to the practitioner depending on the objectives that they have set with their patient.

It is possible to dissociate or associate agonist and antagonist work. Different methods of dynamic workout (where characteristics of strength and speed are adjustable) can be carried out: isokinetic work (under different forms of application, concentric and eccentric[5] combined, possibly with passive return), workout in simulation of manual resistance. (The aided-active mobilisation, active movement against resistance with adjustment of the specification for effort, potentially combined with return to passive mobilisation).

The therapist can compare the injured limb to the healthy limb. This type of machine can provide measurements of speed, displacement, acceleration, and axial force developed by the patient. “This multifunctional aspect of the instrument enables adaptation to different disorders”[4]. An isometric workout (taut-relaxed) completes the variety of possibilities with the same equipment.

Who accompanies the patient by indicating to him/her biofeedback of his/her efforts :

To be involved in their rehabilitation, the patient needs to know what they are doing. Certainly, the perception of oneself is possible during execution of an exercise by means of conscious internal phenomenon or not and of certain perceptions (proprioception, sensation of muscle contraction, etc.), but this knowledge of the process can be promoted by another sense: sight, and more precisely, by the fact of seeing on a screen his / her effort in real time during the execution of his/her movement.

Providing information (visual or other) to the patient about his/her physiological, functional or pathological condition, for the purpose of enabling him/her to correct it, or to improve it, or to maintain is not something new. Generally, the notion of feedback described by Weiner6 in the 1950s, and which has been applied to the living subject (biofeedback) and then to the scope of functional rehabilitation starting in the 1970s, has led to a "therapeutic opening"[7] to management of patients. Since then, the advantages and effects of biofeedback have been demonstrated. Today, even though the principle is recognised by all practitioners, this dimension remains limited in its computerised instrumental use to very specific applications[8].

This new equipment which is of interest here could not be imagined without biofeedback. This equipment is equipped with a computer screen and the patient can see at the same time what he/she is doing and he/she has to do. He/she sees his/her mistakes, he / she understands them simply and can readjust, this is the very principle of biofeedback. What is especially interesting here, with integrated biofeedback, is that the patient has indications[9] on his/her exertions, speed, movement, etc. in brief, the patient has signals which indicate that he/she has succeeded or not. He/she has not only experienced it, he / she has seen it. The device measures and records events in effort and immediately reveals information to the patient, enabling him/her to readjust according to the objectives set at the outset.

It is additional exteroceptive information which is given to him / her by sight and that he / she incorporates himself / herself as a true control of his / her proprioception. This gives him / her the understanding of the movement, it is value-adding and fun. The integrated biofeedback screen is intuitive and simple to understand for the patient, which is a condition for success. It accompanies the patient in the execution of the exercise and in his progress. The fun aspect, the notion of success / error, the motivational dimension enable greater involvement in the patient in his / her rehabilitation. This not only promotes development of awareness of the gesture by means of participation here and now, but also promotes progress from one session to another.

This biofeedback is a given in real time, common to the practitioner and the patient and therefore, el uses the participation of a human relational component. The physiotherapist bases his / her approach on the visual aspect to encourage and provide strategies for progress to his / her patient: "you see, it's better! Let's go, once more, you're going to make it !".

In practice for the physiotherapist? On this type of apparatus, the biofeedback function is immediate, there is no programming, it displays automatically on the screen with no prior adjustment.

Who accompanies and controls dynamic movements :

Up until about ten years ago, it was possible to control static workout very well (example: Troisier's sign), but on the contrary, the great difficulty lay in controlling dynamic efforts. The great revolution in isokinetics at the end of the 1960s was to quantify dynamic effort. First used by US astronauts, it then spread to high level sports sector and was introduced in France in the 1980s[10].

In 2001, the ANAES in its report concluded that the technique has clear interest, both in diagnosis, as well as in

rehabilitation (provided however that basic rules on standardised procedures are complied with and are well established by healthcare professionals). The operation of isokinetic equipment is based on two major principles: control of speed (a constant speed is imposed on movement of a limb segment, instead of imposing fixed resistance on it), control of resistance (resistance varies and self-adjusts in all points of movement to be equal to the force developed by the muscle)10. The technique has a few limits, apart from its cost (which inhibits its circulation) the analytical characteristic of the technique has already been discussed and "isokinetics is an original technique, but is only one component in the overall process of rehabilitation"[11].

Generally, control of dynamic movements is an ambitious challenge: a dynamic movement is very complex because in a dynamic gesture, there is a training phase which is going to play on acceleration and then an execution phase (which is never perfectly at constant speed which can be assimilated to over a short section), and then a deceleration phase (the movement changes again). The more we can follow the dynamic movement, the more it is possible to control, and the more we approximate the physiology of the movement. These characteristics of acceleration and speed are adjustable to these new equipment, thus enabling physiotherapists to approximate even more a physiology movement in terms of intensity, progressiveness, speed (it is possible to configure very simply increasing speed of a workout and then decreasing by allowing to vary independently the phases of acceleration and deceleration, precisely and simply). It is an important advantage which offers more possibilities; the limits of isokinetics are pushed back. Another aspect of a dynamic procedure is that during its execution, there are phases when the force is large and others where the force is lesser. This new equipment makes it possible to perform modulation of force at the same as variation in speed.

The arrival of isokinetics has been a huge step forward, this new generation of equipment by incorporating new adjustments, improves control of a dynamic gesture even more by approximating physiological movement more accurately.

Which allows us to visualise and store results with ease:

Whether in private practice or hospital practice, management of a patient by the physiotherapist requires a certain amount of information to be taken into account and recorded in order to constitute the patient's medical dossier, to establish an assessment (which has become assessment-diagnosis) and to enable dialogue with a healthcare team or with the prescribing doctors[12]. Ideally, in practice the physiotherapist needs to have an evaluation which is suited, as much as possible, to his / her patient's condition and a progress report which he does in order to develop objectives and a strategy (the best possible one) in the rehabilitation course of the patient, and to follow his progression. For this purpose, he makes an inventory of a certain number of indicators "the assessment is a process of evaluation of functional prognosis"[12].

In this context, objective measurement of physical dimensions relating to movement(s) executed by the patient has important advantages and supplements usually collected data. This equipment becomes both a therapeutic device, a supplement to the assessment and diagnosis6, and a tool to follow-up the patient's progress (physiotherapist and patient can follow within one session and between sessions what the patient does, including following a decrease in results). Between sessions or within a session, he can modify and adjust the strategy of healthcare based on the patient's results which have been measured objectively.

Another advantage lies in the fact that the results can easily be communicated. Concerning the assessment and measurement, Viel reminds us that "to be read, it is necessary to send useful, easy to read data. To be believed, it is better to send figures which are not open to discussion"[13]. Here too, results are stored; they can be sent and printed. The practitioner can justify to the social security entities good results or he/she can justify a request for possible further therapeutic approach or additional sessions. In the current dynamics of the profession which seeks to make physiotherapists even more responsible for their practices and which seeks to require them to explain to others that they understand what they are doing, this equipment is especially useful: it provides a snapshot (before baseline assessment) and a snapshot after (final assessment), and it is possible to say if necessary what has

happened between the two (rehabilitation phase, intermediate assessment). This constitutes objective evidence that something has occurred in treatment, it is a figure demonstrating that the situation is improving (beyond the patient's sensation) or that he/she is continuing. For the same reasons, this collection of information should participate in improving the level of relation with the prescribing doctor and promote exchanges with the healthcare team.

Which is rapid in terms of adjustment, easy to use and appropriate for the sector :

In light of the technology of this equipment, the physiotherapist may fear that he will be confronted with overly complex settings, installation and usage limatations and have difficulty in interpreting the output. These are all major disadvantages because they are sources of lost time. What about practice? The designers have used a steering committee for design (comprised solely of physiotherapists), whose role, among others, consisted of ensuring that the control interface was simple and easy to use. Installation of the patient is almost immediate[14] and launching a session is intuitive and fast[15]. Figures and curves are easy to interpret by the physiotherapist and understandable by the patient. Let us note other aspects: the designers have proposed a technology whose floor space is relatively reduced to adjust to the constraints of small professional spaces[16]; a technology whose necessary interactivity (to lead to a change in exercises during a session without having to re-program it) has been planned; lastly, equipment whose cost of investment (which corresponds to a rent similar to other equipment in the sector) no longer restricts isokinetics to research laboratories and to specialised centres, but enables its democratisation (as it is used more widely in private office practice) by adding other functionalities.

Conclusion :

This brief review reconciles machine intelligence and human intelligence, the requirements of physiological and biomechanical behaviour become better understood by the machine and the practitioner's intelligence ensures the command and control. This cooperation in practitioner know-how and possibilities placed in service by scientific advances are guarantees of improvement in care at the service of patients. This improvement augurs therapeutic advances and speed of recovery which reaches the limit of what the physiology will allow.

Physiotherapist Steering Committee with the Scientific Advice of **Gilles Péninou**, Physiotherapist, Healthcare manager, Ph. D. in Biomechanics. -

REFERENCES

1: For example, a movement executed with the upper limb is never a movement in one plane, because it evolves in three dimensions: the hand is going to describe a spatial movement which needs three dimensional freedom.
2 : Genot C., Neiger H., Leroy A., Pierron G., Duffour M., Peninou G. (1983) Kinésithérapie 1- Principes – Bilans, Techniques passives et actives de l'appareil locomoteur. Paris : Flammaroin Médecine-Sciences.
3: Whether younger, older, athlete, sedentary or deficient.
4 : Kapitaniak B. (2011) Rapport d'une expertise d'un dispositif « Kinévolution ».
5: All possible combinations are authorised. For example: eccentric work/passive return, concentric work/passive return, concentric work/ eccentric work, eccentric work/eccentric work enabling agonist/antagonist ratios or concentric work/ concentric work, etc.
6 : Wiener defined cybernetic feedback as "the manner of controlling an overall set of items by allowing us to know results of ongoing actions and therefore the difference between these results which was desired a priori ». According to Couffignal, biofeedback is an "art of ensuring efficacy and action". See Crépon F. (2001) "Utility of myo-feedback", Ann. Kinésithér. , t28 n6, pp261-268. See also Rémond A., &Rémond A. (1994) Biofeedback, principles and applications. Issy les Moulineaux: Masson.
7 : Blanc Y. par Crépon F. (2001) « Intérêt du myofeedback », Ann. Kinésithér. , t28 n6, pp261-268
8: As perineal rehabilitation, use of a baropodometric technical platform, isokinetic dynamometers, etc.
9: Quantitative informations (measures with figures) and qualitative (curves).
10 : HAS (anc. ANAES) (2001) Les appareils d'isocinétisme en évaluation et en rééducation musculaire : intérêts et utilisation. Document téléchargeable sur http://www.has-sante.fr
11 : Croisier J.L., Maquet D., Codine P., Forthomme (2008) « Renforcement musculaire te rééducation : apport de l'isocinétisme », in Kotzki N. et Dupeyron A. (Dir.), Renforcement musculaire et reprogrammation motrice. Issy les Moulineaux : Elsevier-Masson
12 : Viel E. (2006) Bien rédiger le bilan-diagnostic. Issy les Moulineaux : Elsevier-Msson.
13: Not only does the physiotherapist access precise physical data (force, speed, etc.), curves of effort, but also "accidents in the curve"… which it would be useful to compare to symptoms. Generally, figured results obtained can participate in the improvement of understanding of the disorders with which the physiotherapist is confronted.
14: For example, it is not necessary to make adjustments in the machine compared to lengths of the patient's limb segments.
15: Aptitude for use has been certified: 3 seconds is necessary to launch a typical session, 40 seconds to configure a complete session.
16: In private practice, the size of the machines is often an inhibitor to investment in office practice for which the workspace is often limited. The displacement in terms of floor space corresponds to at least 1/3 that of a massage table.