ACUTE HAMSTRING INJURIES IN RUGBY PLAYERS: THE INFLUENCE OF POSITIONING DURING ICE THERAPY ON MUSCLE LENGTH

Becker, D Rayner, L van Zyl, E Walters, C P Malherbe*

SUMMARY

The effect on muscle length of positioning with ice application to acute hamstring injuries in rugby players was examined. Ice was applied with the hamstring muscle group in either the lengthened or the shortened position. Players with grade I or II hamstring injuries were randomly allocated (via the randomized block method) to the different treatment methods. The active hamstring length of the injured leg was measured by means of knee extension before and after treatment on days 1, 2 and 3 post-injury. The uninjured leg was measured on days 1 and 3.
The discussion of results covered only the clinical observations since the experimental group was too small for statistical analysis.

OPSOMMING

Die invloed van posisionering tydens ysbehandeling van die akute hamstringbesering is by rugbyspelers ondersoek. Ys is met hamstringe in die verkorte of in die verlengde posisie toegedien.
Spelers met graad I of II hamstringbeserings is volgens die ewekansige blokmetode aan die verskillende behandelingsmetodes toegewys. Aktiewe hamstringlengte van die beseerde been is voor en na behandeling deur middel van knieekstensie gemeet op dag 1, 2 en 3 na besering. Die gesonde been se metings is op dag 1 en 3 geneem. Die bespreking van resultate is slegs na aanleiding van kliniese waarnemings gedoen, aangesien die steekproef te klein was vir statistiese ontleding.

INTRODUCTION

Clinical work at the Student Health Service in Stellenbosch as well as regular contact with the service made the authors aware during 1988 of the high incidence of muscle rupture, particularly hamstrings, amongst rugby players and athletes.

Complete rehabilitation after a hamstring rupture, i.e. until all the accepted criteria for return to sport[1] have been met, can be lengthy (3 – 9 weeks)[2], and is thus accompanied by considerable loss of playing time. Injured players therefore tend to return to the sportsfield before complete recovery has taken place. Recurrent injury is consequently not simply a high risk but a fact.

The authors realised that really effective treatment was necessary to keep rehabilitation as short as possible. It also appeared that regaining complete suppleness (muscle length), especially of the injured leg (one of the criteria for return to sport), was a problem for the physiotherapist in the sports clinic as far as the hamstrings were concerned.

The authors therefore began questioning the practice of keeping the torn muscle in its relaxed, shortened position during ice therapy in the acute phase. An hypothesis was posed that positioning which lengthened the muscle in the early stages during ice therapy would facilitate the retention and/or improvement of hamstring length and thereby shorten rehabilitation.

LITERATURE REVIEW

Immediately after muscle rupture bleeding appears and an inflammatory reaction develops. The "RICE" regime[3, 4, 5] (rest, ice, compression and elevation) limits these and is essential to the creation of optimal conditions for muscle recovery through the laying down of collagen[6].

However, specific recommendations were found in the literature for the use of positioning which lengthened the muscle. Gray and Wilkerson[4], and Evans[6] maintain that collagen is laid down in a more orderly fashion and the formed fibrous junction is stronger if the muscle is lengthened rather than when there is loss of normal tension on the damaged tissue.

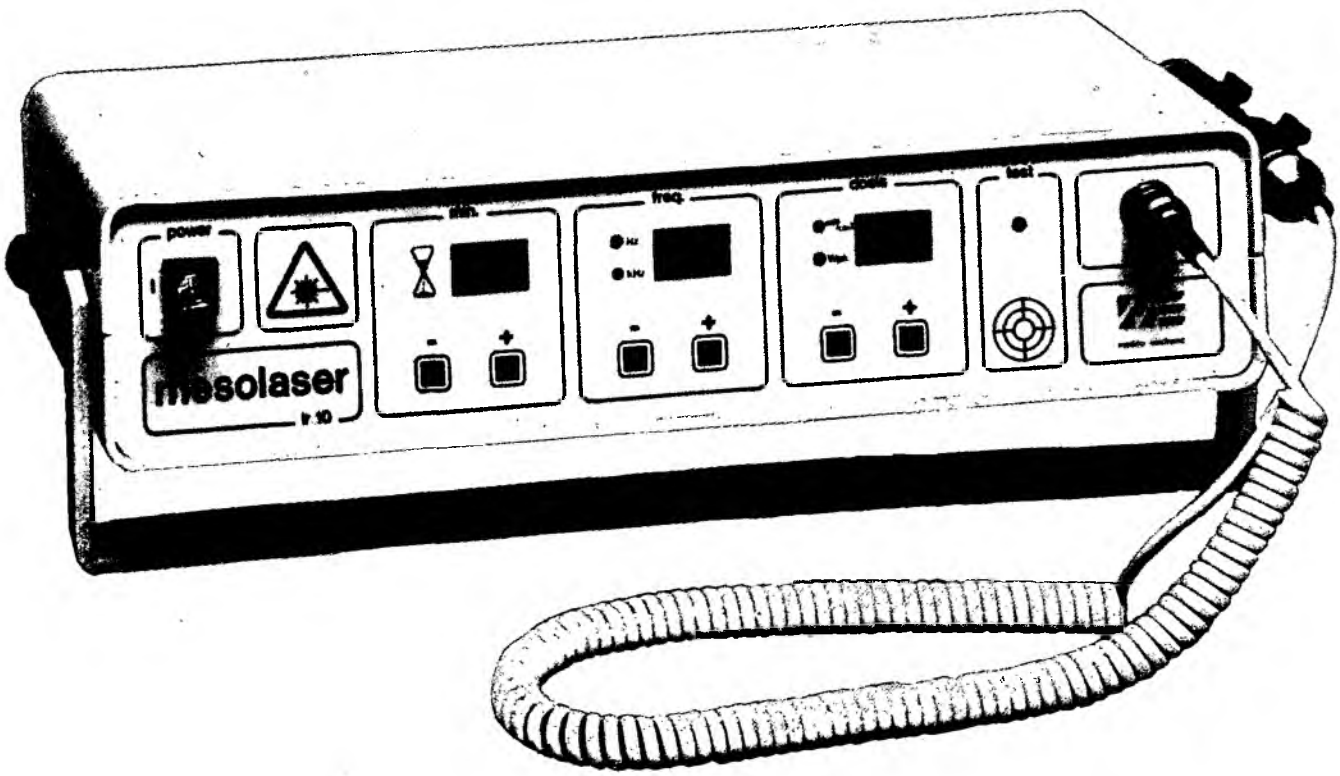
Coole and Gieck[7] specifically recommend that ice therapy takes place in a position that applies a static stretch (sitting with hip flexed and knee extended). They argue that stretching the muscle will stimulate the muscle spindle and increase motor stimulation to the muscle. Reflexive resistance to the stretch is thereby invoked. However, if the stretch is maintained for too long, excessive tension develops in the muscle. The Golgi organ in the tendon is activated. The muscle relaxes and pain diminution follows. The risk of worsening the symptoms is thus slight.

It therefore appears that early lengthening can place the muscle in the optimum length for the laying down of collagen with the object of retaining or achieving muscle suppleness during rehabilitation.

* C Becker, D Rayner, L van Zyl and E Walters, Fourth year BSc Physiotherapy students, University of Stellenbosch 1988.
C P Malherbe, BSc Physiotherapy, *Part-time lecturer*, Department of Physiotherapy, University of Stellenbosch.
Adapted from the student project for the degree of BSc Physiotherapy, University of Stellenbosch, 1988.

Mesolaser IR 01

LICENSED BY THE DIRECTOR GENERAL OF RADIATION CONTROL



- A powerful portable Ga As infra-red laser, which uses the most up to date microcomputer technology
- The wave-length of 904 nm guarantees an optimal penetration depth.
- Variable peak power from 0 to 30 Watt in steps of 1 Watt.
- Capable of changing the frequency from 1 Hz to 5000 Hz.
- Tip-touch sensor system for activating the laser beam.
- Measurement of the infra-red radiation using an optical sensor.
- Time clock which works only when the laser beam is activated.
- Safety glasses designed for laser therapy, consisting of interference filters. These keep the visual spectrum at 95% of normal.
- Unit built to comply with the international safety regulations IEC 601.

DIOMED

MEDICAL DISTRIBUTORS (PTY) LTD (EDMS) BPK

REG. NO. 57/01868/07

(011) 29-6931
(031) 37-1501

(021) 47-4440
(012) 346-1279

Another aspect that came to light was the influence of ice on collagen formation (the plastic and elastic properties of collagen). According to Marino[8] cooling after the muscle has been placed in stretch increases the plastic flexibility of collagen. The collagen fibres therefore lengthen. This gives further support to the use of positioning that lengthens the muscle, but will apply only from day 4 or 5, after the collagen has been laid down.

METHOD

Research question

Against this background the following question was posed:

Is the improvement in hamstring length on day 2 after rupture greater after ice application with the muscle in a lengthened position than in the traditional shortened position?

Study structure

The investigation was carried out as a random clinical study of residence league rugby players at the University of Stellenbosch. They had suffered grade I or II hamstring rupture (in any part of the muscle belly) during games or practices between 11 April and 29 May 1988 and had reported to the emergency clinic within 30 minutes of the injury. An age limit of 18 – 25 years was set.

Criteria for exclusion

Exclusion criteria included:

- club players
- grade III and IV hamstring ruptures
- previous hamstring injuries suffered since April 1987
- back and leg injuries not yet fully healed
- hypersensitivity to ice[9]

Hamstring ruptures were graded by the student doctor according to a combination of the classification systems of Fox[1] and Oakes[10]. Fox's classification is subjective and vague in regard to the degree of pain, swelling and muscle spasm but gives usable objective values for the loss of knee extension. The classification of Oakes rests on the history of the injury and gives a clear definition of interference with function as a result of pain, swelling and muscle spasm. The latter offers a more concrete evaluation method.

Instrumentation

Chemical ice packs 23 x 16 cm from Medac were used for ice application. Their temperature is chemically regulated to remain at 0°C for 20 minutes[8], which also limits the danger of freeze burns.

Measurement of pain was done by means of a subjective pain scale with 0 = no pain and 10 = severe pain[11].

Hamstring length was measured by active knee extension of the leg to the point where myoclonus occurred (the active knee extension test – AKET[12]). The thigh was stabilised in hip flexion during measurement by binding it to a steel rod fixed to the plinth. The pelvis and uninjured leg were secured to prevent pelvic tilt.

Measurement in degrees was done with an electronic resistance meter built in between the two arms of a pendulum goniometer and connected to a computer. Changes in tension are registered and converted by an analog-to-number converter into degrees of movement which are then shown by the computer. Each measurement was taken twice. If the two readings differed by more than 5° the computer automatically rejected them. The average of the two readings was shown.

Procedure

The injured player came directly from the field and reported to the emergency room. Once the degree of injury had been determined the players were allocated according to the random block method to the two methods of treatment – positioning seated with knee extension compared with prone with knee flexion. Grade II injuries were allocated separately from grade I.

The players were followed up for three days: the first night in the emergency room; on days 2 and 3 in the morning at the student health clinic and in the evening at the emergency room. The appropriate positioning and ice application was done on each occasion (4 times).

The pain scale was filled in by the player before and after each application of ice.

Hamstring length of the injured leg was measured before and after each afternoon's ice therapy and was later compared with that of the uninjured leg which was measured on days 1 and 3. All measurements were taken by the same researcher.

After day 3 the players were referred for follow-up treatment.

The ice packs were applied for 20 minutes on the most painful area. Compression was applied by binding the pack with a crepe bandage. Elevation was not possible with the standard positionings.

The positioning for treatment method A stretched the hamstrings in the sitting position over the hip as well as the knee. The heel was placed on a 7 cm block to ensure knee extension and combined with maximum hip flexion by means of adjusting the head of the plinth within the limits imposed by pain.

The position for treatment method B was prone with knee flexion; thus the hamstrings were shortened and relaxed over the hip and knee.

"Basketweave" bandages were applied after treatment for grade II injuries. No crutches were supplied.

The following written instructions were given to each player:

- If pain is experienced ONLY Panado may be taken (no anti-inflammatory drugs). No medication could be taken after 12 noon on days 2 and 3.
- No sporting activities such as jogging or bicycle riding were allowed for 48 hours after injury.
- No preparations, e.g. Deep Heat, Wintergreen, Reparil Gel or Heat Rub could be applied to the injured area.
- No other home treatment could be used.

RESULTS

Of a total of 9 hamstring injuries suffered during the set period only 5 players complied with the criteria : 1 wing, 2 fullbacks and 2 centres. Four grade I and one grade II injuries were seen.

The first and last measurements (day 1 and day 3) of the

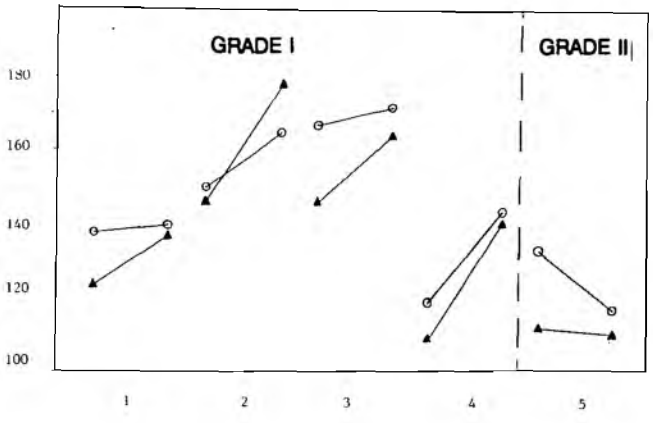


FIG 1. First and final measurements (day 1 & day 3) of hamstring length: control leg (O) versus injured leg (Δ)

injured and control leg of the different individuals are shown in figure 1.

Figure 2 represents the changes in hamstring length of the injured leg, in degrees, before and after treatment over the three days.

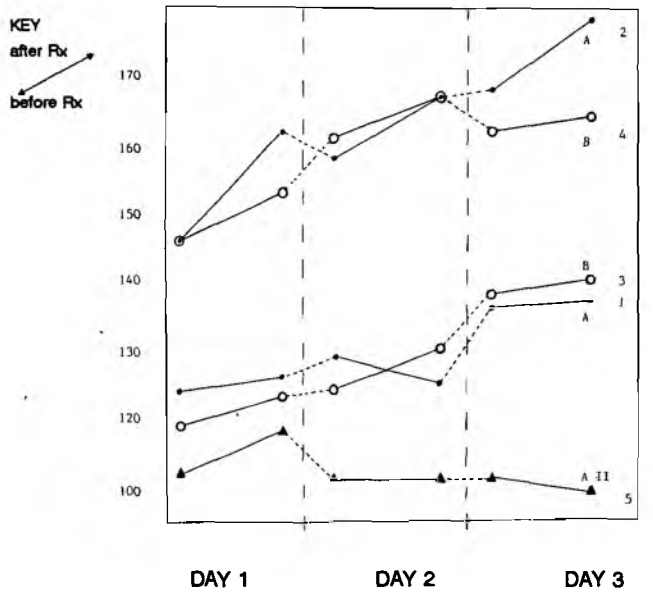


FIG 2. Hamstring length of the injured leg before and after treatment over three days

The pain scale data showed a definite reduction in pain after each treatment and a progressive diminution of pain over the three days in all five players.

DISCUSSION

The unsatisfactory experimental group did not allow of statistical analysis. Discussion of the results is therefore based solely on the observations of the researchers.

From figure 1 it is clear that the readings of the control leg could not be taken as normal for the specific individual and therefore could not be used as a reference point because of the great difference in readings on day 1 and day 3 in two of the four grade I injuries.

It was anticipated that measurements of the control leg on day 3 would be lower because the individual was still warmed up and supple on day 1 as a result of the exercise or game. This was noticed only in the grade II injury (figure 1). No warming up was done by the players before measurement on day 3. Readings on day 3 were, however, higher. This could possibly be due to the influence of pain in the injured leg and unfamiliarity with the measurement procedures on day 1.

Regarding the measurements of the injured leg:

In 3 of the 4 cases with grade I injuries the final reading of the injured leg was lower than that of the control leg (figure 1). This was, however, to be expected because damaged muscle fibres limit muscle length. The grade II injury supports this.

The authors expected that measurements after treatment would be higher than before treatment because of the influence of ice and positioning (both shortened and lengthened positions) on the muscle length of the damaged muscle. This was clinically substantiated in the grade I injuries as seen in figure 2. Only in 1 out of 12 treatments was no improvement observed.

In the case of the grade II injury there was no improvement after one treatment and by the last treatment there was a lessening of muscle length (figure 2). This could be ascribed to the more serious injury with more muscle spasm and pain.

Figure 2 shows that both treatments A and B were effective. It was not possible, however, to draw a comparison between the effectivity of the two treatments.

The findings of the subjective pain measurements are an indication that both treatments, and therefore both positions, were effective in regard to the subjective diminution of pain. It could not be established which treatment was better.

All the injured players were back line players. This confirms the facts from the literature that players who do a lot of pace work have more type II fibres and are more liable to injury[13, 14].

CONCLUSIONS

Judged clinically both treatments A and B were generally effective in regard to the reduction in pain and the improvement of hamstring muscle length during individual treatments from day 1 to day 3.

It appears from the loss of muscle length after day 3 in the grade II injury that conventional "RICE" treatment alone is not sufficient in the case of acute grade II injuries. The possibility exists that anti-inflammatory drugs will encourage more rapid recovery of muscle length in this case.

The research question could not be answered by testing the hypothesis because statistical procedures could not be used for the very small experimental group. This study can, however, be seen as preliminary to further research in this connection. No practical problems were encountered in carrying out the general or specific procedures. The difference in the measurements of the healthy leg need not handicap the study. The authors have proved that the study is practically feasible. It is strongly recommended that, for the sake of statistical significance, the study be continued to collect more data.

The study should, however, be carried out over a longer period and/or more sports such as soccer and hockey should be included to assemble an adequate test group.

It is recommended that if the project is followed up, measurements should also be taken after three weeks. This would enable it to be established whether the treatment in the acute phase had a lasting influence on muscle recovery.

NEW

MedSolve ...
Now incorporating New Dispensing Module!

During the 1980's, *MedSolve* revolutionised practice management.

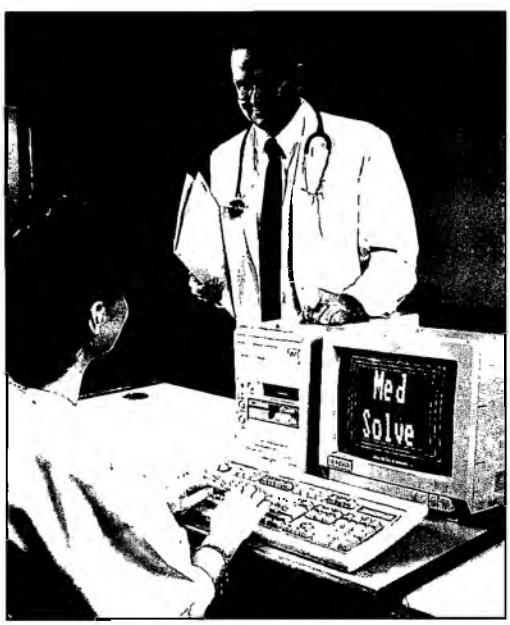
FACT: Practice management in the '80's demanded quick, successful solutions. *MedSolve* gave you just that *and* revolutionised day-to-day operations control and now have over 1500 installations to illustrate its success. But the '90's will present new challenges and new frontiers. Existing first generation practice management systems will simply be unable to cope.

THE GOAL: To develop a comprehensive medical practice management system that will take you into the 1990's and well beyond.

THE NORIDATA ACHIEVEMENT:

The NEW *MedSolve* from Noridata.
Your ***2nd generation practice management system.***

This NEW version of *MedSolve* incorporates the latest programming techniques and languages, and represents the technological sophistication which users will come to expect from a fully integrated computerised practice management system.



THE NORIDATA OFFER:

Attend a NEW *MedSolve* demonstration today and we will show you how MedSolve can bring immediate benefits to your practice and improve your cash flow
NEW *MedSolve* from Noridata. The first thing we install is confidence.

NORIDATA
DIVISION OF NORISTAN LIMITED

For more information please complete and return the coupon below or telephone Noridata at (011) 484-4380 or (021) 531-0944.

MedSolve
South Africa's most successful practice management system

Will you or your nearest dealer please contact me with more information on NEW MedSolve

NAME _____

ADDRESS _____

TEL _____ *CODE* _____

NORIDATA
DIVISION OF NORISTAN LIMITED

JOHANNESBURG BRANCH
PO BOX 31469
BRAAMFONTEIN
2017
TEL (011) 484-4380

CAPE TOWN BRANCH
HOWARD STUDIO
HOWARD PLACE
PINELANDS 7405
TEL (021) 531-0944

SAL 1265/A4D

REFERENCES

1. Fox JM. Injuries to the thigh. In: Nicholas J and Hershman E, eds. *The Lower Extremity and Spine in Sports Medicine*. Toronto: The CV Mosby Company, 1986: 1987-1117.
2. Reese R. Athletic training techniques and protective equipment. In: Nicholas J and Hershman E, eds. *The Lower Extremity and Spine in Sports Medicine*. Toronto: The CV Mosby Company, 1986: 319-321.
3. Coilek JJ. Cryotherapy: Review of physiological effects and clinical application. *Cleveland Clinic Quarterly* 1985; **52(2)**: 193-201.
4. Gary B and Wilkerson ATC. External compression for controlling traumatic oedema. *The Physician and Sports Medicine* 1985; **13(6)**: 97-106.
5. McMaster WC. A literary review on ice therapy in injuries. *American Journal of Sports Medicine* 1977; **5(3)**: 124-126.
6. Evans P. The healing process at cellular level: a review. *Physiotherapy* 1980; **66(8)**: 256-259.
7. Coole WG and Gieck JH. An analysis of hamstring strains and their rehabilitation. *The Journal of Orthopaedic and Sports Physical Therapy* 1987; **9(2)**: 77-84.
8. Marino M. Principles of therapeutic modalities: implications for sports medicine. In: Nicholas J and Hershman E, eds. *The Lower Extremity and Spine in Sports Medicine*. Toronto: The CV Mosby Company, 1986: 233-241.
9. Harrison M. Effects of ice treatment. *Physiotherapy in Sport* 1978; **2(1)**: 8-10.
10. Oakes BW. Hamstring muscle injuries. *Australian Family Physician* 1984; **13(8)**: 587-591.
11. Elton D, Burrows GD, Stanley GV. A multidimensional approach to the assessment of pain. *Australian Journal of Physiotherapy* 1979; **25(1)**: 33-37.
12. Gajdosik R. Hamstring muscle tightness: reliability of an active knee extension test. *Physical Therapy* 1983; **63(7)**: 1085-1090.
13. Garrett WE. Histochemical correlates of hamstring injuries. *The American Journal of Sports Medicine* 1986; **12(2)**: 98-103.
14. Garrett WE. Basic Science of musculotendinous injuries. In: Nicholas J and Hershman E, eds. *The Lower Extremity and Spine in Sports Medicine*. Toronto: The CV Mosby Company, 1986: 42-56. ♥