OBJECTIVE ROENTGENOLOGIC MEASUREMENTS OF THE INFLUENCE OF ANKLE BRACES ON PATHOLOGIC JOINT MOBILITY. A COMPARISON OF 9 BRACES

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The stabilizing effect of external support (taping and nine different ankle braces) was tested in a total of 220 functionally unstable ankles. A standard surface EMG controlled stress Roentgen test protocol was used, measuring talar tilt (TT) without support and with tape bandage or brace. Different levels of TT restraining by external support could be identified. Tape bandage and two braces had a highly significant influence on the talar tilt. The mean TT without support was decreased by using tape from 13.4° to 4.9°, by using one brace to 4.8° and by using another brace to 5.9°. These two braces are effective for protection during functional treatment. A classification into three grades of effectiveness is proposed. It is concluded that the stabilizing influence offered by bandages and braces should be measured before using the external support as a treatment device for acute ankle sprain and as a reliable protection against sprain injuries in daily living and sports.

Keywords : ankle instability ; ankle Roentgen stress ; talar tilt ; ankle orthesis ; ankle taping ; ankle bracing.
Mots-clés : instabilité de la cheville ; radiographie dynamique de la cheville ; bascule astragalienne ; orthèse de cheville ; chevillière ; taping de la cheville.

INTRODUCTION

Braces are designed to provide partial immobilisation and external support to protect the joint complex, to limit traumatizing stretch on soft tissues around the joint immediately following trauma and to prevent repetitive joint sprain (29, 27, 28, 36). Influence of bandages and ortheses on proprioception has been reported in studies evaluating postural control and kinesthetic awareness (2, 5, 11, 20, 22, 23). Mechanical stabilisation by bandages and braces has been investigated measuring influence on mobility, eversion strength and athletic performance (13, 16, 27, 3, 1, 9, 10). Effective influence on pathologic hypermobility and instability of the ankle by bandages and braces (table I) used to partially immobilise the ankle during functional post trauma treatment and sprain prevention has, however, been insufficiently investigated. This is surprising because it has been shown that functional treatment is the treatment of choice for severe acute ankle sprain trauma (31).

In the case of the joints of the ankle, instability can be documented evaluating *mechanical hypermobility* using stress Roentgen tests and *functional instability* using stabilometry, joint position sense

Table I. — Terminology of external support or partial immobilisation

bandage	=	non adhesive and elastic
strapping	=	adhesive and elastic
taping	=	adhesive and non-elastic and
bracing	=	the pre-fabricated external support

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and joint motion detection sensibility (32, 7, 19, 21, 15, 11, 18, 20).

The influence of (non elastic) tape bandage on pathologic talar rotation (34, 39) was documented measuring influence on talar tilt. Using the same tests with an external support, bandage or brace on the ankle allows a comparison of the stabilizing effect of these devices (table I).

The purpose of this study is to examine the influence of different types of external support on pathological mobility, thereby initiating the objectivation of the stabilizing effect of orthoses on the impaired and often disabled ankle joint function.

MATERIALS AND METHODS

Since 1987 several groups of patients with chronic unstable ankles have been investigated independently to measure the presence of pathologic mobility in the tibiotalar joint. Inclusion criteria were a history of ankle sprain trauma and complaints of functional ankle instability. These functional complaints were repetitive spraining and/or fear of giving way of the ankle. The tests were carried out at least 6 months following ankle sprain trauma. Exclusion criteria were a history of fracture of the ankle, pain and incapacity to relax during the stress procedure. Ankle taping (fig. 1) and nine different ankle braces have been studied in the different subsamples described in table II.

A standard Roentgen ankle stress procedure was applied using an adapted version of the Inman 14 ankle apparatus (33, 34). With the patient in the supine position and the foot in plantar flexion, the ankle is stressed in inversion using a charge of 15 kg.

Obviously muscle activity can introduce a bias in the measured TT. Therefore surface EMG of the m. peroneus longus was carried out and only painfree tests with relaxed ankle evertors showing an EMG signal inferior to 10 microvolts were accepted (Myotron 222, Enting Instruments & Systems, Dorst, The Netherlands).

Several preliminary tests were performed. A sample of patients was tested twice without a brace to measure reproducibility of the stress procedure. Another sample of randomly selected stress Roentgen images was copied twice and read separately by three investigators to evaluate interobserver error of the TT angle measurement. In several patients the stress test was also carried out before and after a physical activity session

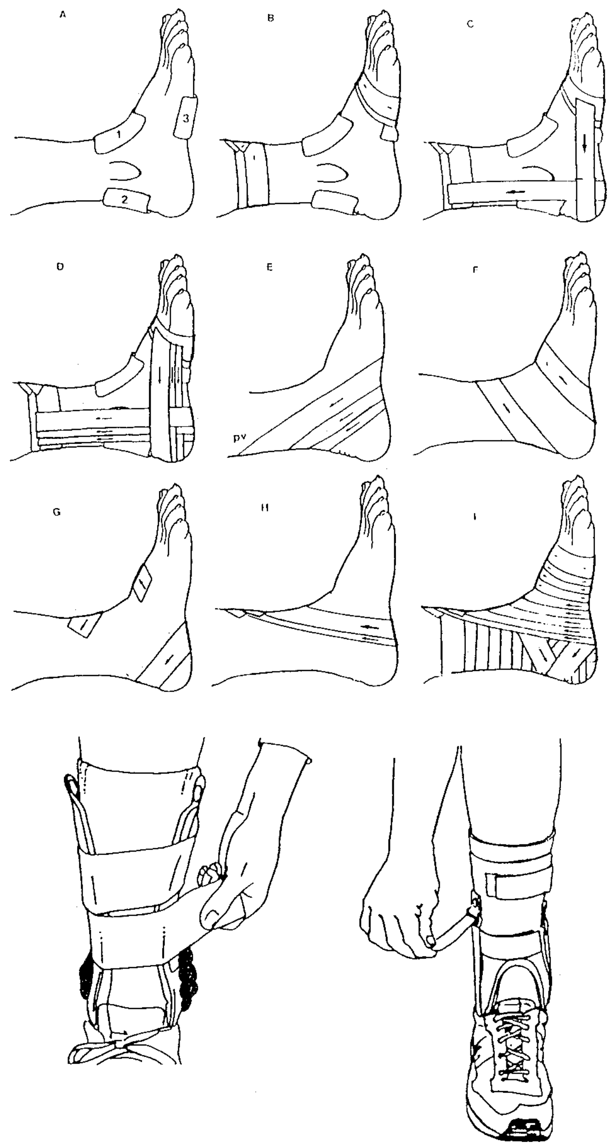

Fig. 1. — Ankle taping (A-I), Step-In Safety brace (right), Aircast standard brace (left).

without an external support to evaluate the influence of the activity on the Talar Tilt.

For the proper evaluation of the influence of the external support, the ankle was first tested without the brace, followed by a Roentgen stress test with the support. A comparison was made between the TT measured without and the TT measured with the brace.

Finally, the influence of using the tape or brace during activity was evaluated. Changes of TT following a 30 minutes "figure of 8" running, jumping and jogging

Table II. — The different types of external support examined in the present study

1. Tape bandage (Beiersdorf, Germany) = TA (n = 51)
2. Malleoloc ankle brace (Bauerfeind, Germany) = MA (n = 14)
3. Medium Push brace (NEA-International, the Netherlands) = MP (n = 12)
4. Heavy (medical) Push brace (NEA-International) = HP (n = 31)
5. Aircast Standard ankle brace = AI (Aircast Inc) (n = 41)
6. Step-in Safety ankle brace (Sweden) = SI (n = 17)
7. Micros ankle brace (Canada) = MI (n = 15)
8. Ankle ligament protector (Smith & Nephew Donjoy Inc, Carlsbad, CA) = AL (n = 15)
9. Swede-O Universal ankle brace (North Branch, MN, USA) = SW (n = 15)
10. Rocketsock brace (Smith & Nephew Donjoy Inc, Carlsbad, CA) = RS (n = 9).

programme were registered by repeating the stress test after activity.

The reproducibility of the stress procedure was ascertained by means of the product-moment correlation and a paired t-test.

The with/without findings were compared using the paired t-test for each brace independently. The comparison between the influence of different braces on TT was made using a one way ANOVA followed by the DUNCAN a posteriori test, most sensitive in recognizing differences.The difference between the TT measured with and without brace was used as dependent variable in the ANOVA. The difference between the TT before running with tape/brace and the TT after running was evaluated using paired t-tests.

RESULTS

A total of 220 functionally unstable ankles were examined (68% female patients, 32% male). Mean age was 29, with a range from 16 to 43 years.

(1) *Testing of the reproducibility of the method.* Repeating the procedure twice in 36 ankles showed a non significant difference (p = .159) and a highly significant correlation (r = .88) between the two series of TT measurements on stress Röntgen films (table III).

(2) *Measuring error.* Calculating talar rotation showed an operator error of ± 0.5°.

Comparing TT measurements on 3 × 33 Roentgen images copies of unstable ankles, three independent operators did not differ significantly (table IV). A repeated measures ANOVA yielded a F-ratio of .41 (p = .66) and an Intra Class Correlation Coefficient of .99. The highest mean inter observer difference between the 3 series has an upper limit of 0.25° (99% confidence interval).

(3) *Influence of activity on TT.* It was shown that a running and jumping test of the unsupported ankles by 8 volunteers in between two Roentgen stress tests did not significantly change the TT measurements (table V).

Table III. — Results of the reproducibility test of the stress procedure

Repeating ankle stress	n	X	SD	Min	Max	p	r
first	36	6.5	2.4	3	12.5		
second	36	6.8	2.8	3.5	13.5		
difference TT	36	.32	1.3			.159	.88

Table IV. — Results of the repeated measurements by three independent operators, no significant differences were found between the measurements

Repeating measurements	n	X	SD
first	33	11.74	7.76
second	33	11.71	7.64
third	33	11.67	7.77

Table V. — Results of TT measured before and after running without external support in 8 volunteers with ankle instability

Effects of activity	n	X	SD	Min	Max	p
before	8	13.0	4.5	7.5	22.0	
after	8	13.1	4.7	8.0	23.0	
difference						0.802

(4) *Effects on TT of 10 types of external support.* Table VI displays the differences in talar tilt (TT) without and with tape or 9 types of braces. With two of the braces, numbers 5 and 6 (fig. 1), the difference between the TT measured without the brace and the TT measured with the brace was highly significant ($p < .001$) (fig. 5). The decrease in TT mobility achieved with these two braces is comparable to the significant decrease produced by the application of tape (8.3° and 7.0° versus 8.4°) (fig. 2). Two braces (numbers 2, and 4) lowered the TT to a lesser but significant extent : 2.7° and 3.8° ($p < .05$) (fig. 3). Five braces (numbers 3, 7, 8 9 and 10) had no significant influence on talar tilt (fig. 4).

The one way ANOVA between the differences in TT reduction found in the 10 groups indicated a significant difference of the influence on TT between the braces ($F = 19.28$, D.F. = 9 ; 210, $p < .001$). Table VII shows the results of the retrospective comparison between the effects of the 9 different braces and the tape (DUNCAN procedure, $p = .05$). The effect on TT increases from left to right.

The underlined numbers (see table II for identification of types of braces) indicate the homogeneous subsets of braces/external support. There are no significant differences in effect on TT within one subset.

Three subsets can be identified *. The DUNCAN test confirms the existence of the first group.

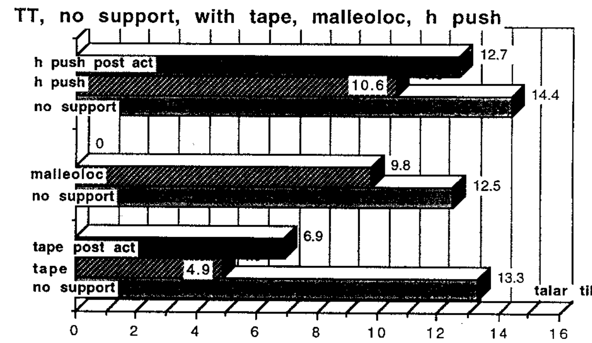

Fig. 3. — Influence of taping, Heavy Push and Malleoloc braces on talar tilt.

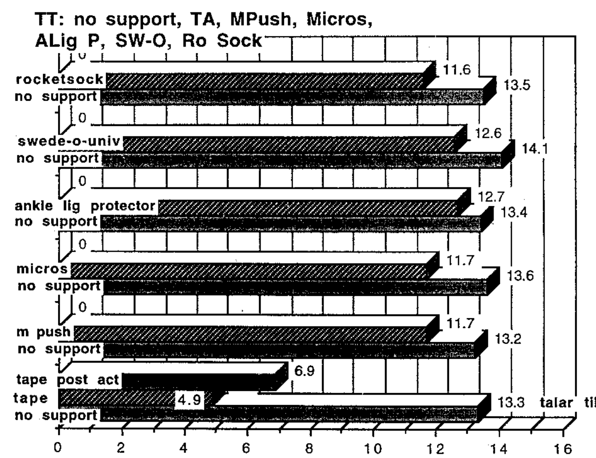

Fig. 4. — Influence of taping, and 5 braces on talar tilt.

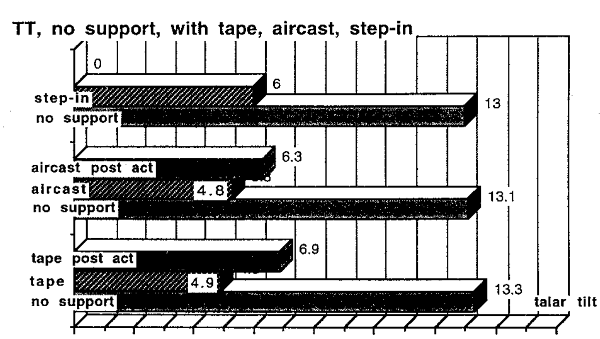

Fig. 2. — Influence of taping, Step-In Safety and Aircast Standard braces on talar tilt.

* (1) The braces 8, 3, 9, 7, 10 and 2 in the first subset have the lowest influence on TT and do not differ among themselves.

(2) The next subset overlaps partly with the first. It contains braces 3, 9, 7, 10, 2 and also 4. These braces do not differ significantly among themselves.

(3) The final subset contains the types of external support with the highest effect on TT : braces 6, 5 and the tape (1). The highest subset confirms the findings shown in table V. A highly significant ($p < .001$) reduction of TT was measured with the Tape bandage, Aircast Standard brace and Step In Safety brace. These three do not show significant differences among themselves.

Table VI. — Talar tilt measurements of the examined ankles without and with the bandage or 9 types of braces. Mean values without support, with brace and differences are reported

bandage/brace	TT without			TT brace		
	n	mean	SD	mean	SD	p
1. TA	51	13.3°	4.5°	4.9°	3.2°	< 0.001
2. MA	14	12.5°	3.2°	9.8°	3.3°	0.034
3. MP	12	13.2°	4.8°	11.7°	4.7°	0.447 ns
4. HP	31	14.4°	5.0°	10.6°	4.6°	0.003
5. AI	41	13.1°	6.2°	4.8°	3.3°	< 0.001
6. SI	17	13.0°	3.4°	6.0°	1.9°	< 0.001
7. MI	15	13.6°	4.5°	11.7°	3.8°	0.220 ns
8. AL	15	13.4°	6.2°	12.7°	6.1°	0.711 ns
9. SW	15	14.1°	5.6°	12.6°	5.0°	0.446 ns
10. RS	9	13.5°	4.2°	11.6°	3.5°	0.301 ns

Table VII. — Comparisons between different types of external support (DUNCAN a posteriori test). Homogeneous brace subsets are shown as underlined results that are not significantly different within the subset

	tape/brace #
Homogeous brace subsets :	8 3 9 7 10 2 4 6 5 1
effect on TT :	low >>>> high

(5) *Durability of the support after physical activity.* In the series of tests that were performed, it was also investigated how well the support is maintained after activity. Table VIII shows the reliability of the external support following active exercises. This was investigated for tape, Medical (heavy) Push brace and Aircast Standard.

Results show a loss of support as measured by a significant increase of TT ($p < .001$) with the tape bandage and the Push brace following activity when compared to the immediate effect on TT of the same external support.

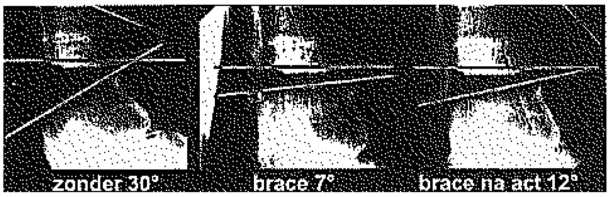

Fig. 5. — Example of one case : TT without support (30°), with brace (7°) and with brace post activity (12°).

In unstable ankles with the Aircast Standard brace the TT does not increase significantly ($p = 0.103$) following physical activity. Using this brace during the vigourous exercises does not significantly deteriorate the quality of support.

DISCUSSION

Instability of the ankle joint is more than a mechanical problem. Effects of external support can be evaluated measuring mechanical and proprioception deficiencies. Because on average only about 35% of patients with complaints of ankle instability show hypermobility (32, 37), other methods for testing effects of external support should be explored. Evaluating proprioception deficits and studying these in braced situations can offer new information. Test procedures have been

Table VIII. — Comparisons of the TT measurements of tape, Heavy Push brace and Aircast Standard brace versus the respective post activity values ; comparison of the original unsupported TT versus the 3 post activity values

Talar Tilt	n	mean-SD before activity	mean-SD after activity	p
TT tape - TTt post	51	4.86°±3.17°	6.94°±3.34°	< .001
TT - TTt post	51	13.29°±4.53°	6.94°±3.34°	< .001
TT Push - TTP post	31	10.59°±4.58°	12.74°±4.51°	< .001
TT - TTP post	31	14.40°±4.99°	12.74°±4.51°	< .05
TT Aircast - TTA post	25	5.26°±2.80°	6.28°±3.55°	.103
TT - TTA post	25	13.09°±6.20°	6.28°±3.55°	< .001

carried out in the standing position, measuring standing talar tilt (37) and during simulated sprain, measuring dynamic talar tilt, evertor muscle activity and control of sprain movement. These functional and dynamic tests measuring influence of external support on sprain speed and muscle reflex have provided additional information. An objectivation of the influence on proprioception by the two class 1 ankle braces in a more functional position was reported (38).

The clinical importance of bandages and braces is emphasized in the description of the optimal management of the ankle sprain trauma and ankle instability. The Canadian, French and Dutch standards show that there is a clear shift towards a consensus (4, 25, 30). Knowing the high frequency of posttraumatic complaints it is imperative to diagnose and select serious ankle sprains for treatment and to apply a reliable protection during a period of three weeks. This therapy for ankle sprain trauma (grades 3 and 4 (12)) is limited to one week of rest (splint) and three weeks of partial immobilisation (functional treatment). During the period of partial immobilisation (taping) the ankle is gradually loaded as pain permits. Physical therapy follows only if functional impairment is still present after 3 to 4 weeks. Due to the absence of qualified personnel to administer a high quality bandage or to allergic reactions of the skin, the functional treatment with the use of non elastic adhesive bandage (taping) is often replaced by ankle bandages and braces of all kinds. Before initiating comparative studies of therapeutic effects obtained with braces, stabilisation of the orthoses should be investigated.

It is well known that healing of damaged collagen tissue results in superior resistance of fibres against traction if healing takes place under functional loading. This is shown to facilitate better fibre alignment (6, 25). It is important to selectively permit function during the second, third and fourth post trauma week. Therefore it is necessary to use a form of external support that can avoid disruptive traction to the healing capsular and ligamentous tissues. The examination of the effects on hypermobility of different means of external support can help to indicate if disruptive traction of the healing capsular and ligamentous tissues can be lowered or even avoided. A measurement of this hypermobility caused by previous joint sprain(s) can be performed.

For the application of braces immediately following ankle sprain trauma the mechanical support reported in this paper is most important. Influences on proprioception were not examined in this study, possible influences of braces on proprioception cannot be excluded and could enhance stabilising effect by braces.

Although TT remains a controversial parameter in the diagnosis of acute ankle sprains (24) it is accepted as a measurement of mechanical hypermobility in chronic unstable ankles (18, 26, 28). Talar tilt represents a more relevant and precise parameter compared to externally measured mobility (8, 16, 17).

It remains important to re-test braces following physical activity with the brace. Looking at the loss of support in tape and two braces post activity it should be examined how much support remains effective with those braces that already offered limited initial support.

It should also be noted that TT does not always occur at the end of the "forced" range of motion (27). Since braces sometimes limit TT considerably in one ankle and have a rather poor influence on the other, dynamic fluoroscopy was carried out in different unstable ankles. It was observed that in those individuals with rather stiff joint ligaments, TT already appears in the beginning of the inversion stress movement. This was in contrast with the more lax ligamentous individuals where the TT only starts in the final phase of the inversion stress. One should therefore expect a good limitation of talar tilt using tape or brace in the latter. In those the stress is divided over the different joints of the foot and ankle while in case of rigid physionomy the high rigidity of the joint capsules and ligaments will not permit stretch and the tension created by the inversion movement of the foot will immediately stress the tibiotalar joint.

The comparisons reported in this paper are only valid if the basic samples are equivalent (see table V). The similarity of the means and standard deviations among the 10 different groups (for the TT without tape/brace) was tested and supports the assumption of equivalence, as well as the inclusion and exclusion criteria used in the study. Considering the limited populations in some of the series, one should be careful in generalising the present findings.

CONCLUSION

These findings indicate that it is clinically relevant to classify "mechanically" different means of external ankle support and describe more specific indications.

The following classification can be proposed :

Class 1 braces. — Objectivated highly significant ($p < 0.001$) influence and pathologic TT limited to physiologic value. In the present study braces n° 5 and 6 comply with these criteria.

Indication. — Immediate posttrauma and prevention of sprain. This level of stabilisation is also obtained by a (correct) tape bandage.

Class 2 braces. — Objectivated significant ($p < 0.05$), but limited influence on pathologic TT and no objective significant ($p > 0.05$) influence on pathologic TT.

Indication. — Limited prevention of traumatic sprain in chronically unstable ankles (sports and risk activities), comfort and compression, possible enhancement of proprioception.

Further investigation of the influence of braces on proprioception can permit more specific description of indications.

Our classification of the different braces is legitimated by the presence of highly significant ($p < 0.001$), significant ($p < 0.05$) and non significant differences when comparing the decrease of TT obtained with the orthoses.

It should be remembered that highly significant influence means a very low risk (type I error) of falsely accepting effects. In the $p < 0.001$ situation this risk is 10 to 50 times smaller than in the $p < 0.05$ (but $p > 0.01$) situation, and more than 50 times smaller in the $p > 0.05$ situation.

Another argument in favour of this classification is that the braces producing a highly significant correction of TT, limit the TT to a value lower than the physiologic value of 7° (14). Taped ankles and ankles with class 1 braces limit TT to respectively 4.9°, 4.8° and 6.0°. All other braces score 9.8° or higher.

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REFERENCES

1. Alves J., Alday R., Ketcham D., Lentell G. A comparison of the passive support provided by various ankle braces. J. Orthop. Sports Phys. Ther., 1992, 15, 10-18.
2. Bennell K., Goldie P. The differential effects of external ankle support on postural control. J. Orthop. Sports Phys. Ther., 1994, 20, 287-295.
3. Bruns J., Staerk H. Mechanical ankle stabilisation due to the use of orthotic devices and muscular strength. Int. J. Sports Med., 1992, 13, 611-615.
4. Conférence de consensus en médecine d'urgences de la société Francophone d'Urgences médicales, Roanne, 28 avril 1995. Réan. Urg., 1995, 4, 491-555.
5. Feuerbach J., Grabiner M., Koh T., Weiker G., Effect of an ankle orthosis and ankle ligament anesthesia on ankle joint proprioception. Am. J. Sports Med., 1994, 22, 223-229.
6. Frankel V., Nordin M., Snijders. Biomechanics of the skeletsystem. Uitg. De Tijdstroom, Lochem, Gent, 1984.
7. Garn S., Newton R. Kinesthetic awareness in subjects with multiple ankle sprains. Phys. Ther., 1988, 68, 1667-1671.
8. Gebing R., Fiedler V., Röntgendiagnostik der Bandläsionen des oberen Sprunggelenks. Radiologe, 1991, 31, 594-600.
9. Gross M., Bradshaw M., Ventry L. Comparison of support provided by ankle taping and semirigid orthosis. J. Orthop. Sports Phys. Ther., 1987, 9, 33-39.
10. Gross M., Lapp A., Davis J. Comparison of Swede-O-Universal Ankle Support and Aircast Sport-Stirrup Orthoses and ankle tape in restricting Eversion-Inversion before and after exercise. J. Orthop. Sports Phys. Ther., 1991, 13, 11-19.
11. Heit E., Lephardt S., Rozzi S. The effect of ankle bracing and taping on joint position sense in the stable ankle. J. Sport Rehabilitation, 1996, 5, 206-213.
12. Handelberg F., Vaes P. A five grade classification for acute ankle sprain. Orthopaedica Belgica, Essene, June 1996 (abstract).

13. Hughes L., Stetts D. A comparison of ankle taping and a semirigid support. Phys. Sportsmed., 1983, 11, 99-103.
14. Inman V. The joints of the ankle, Baltimore, The Williams and Wilkins, 1976, pp. 69-74.
15. Jerosch J. The influence of orthoses on the proprioception of the ankle joint. Knee Surg., Sports Traumatology and Arthroscopy, 1995, 3, 39-46.
16. Karlsson J. Chronic lateral instability of the ankle joint. A clinical, radiological and experimental study. Thesis Gothenburg University, 1989.
17. Karlsson J., Bergsten T., Peterson L., Zachrisson B. Radiographic evaluation of ankle joint stability. Clin. J. Sport Med., 1991, 1, 166-175.
18. Konradsen L., Voigt M., Højsgaard C. Ankle inversion injuries, the role of the dynamic defence mechanism. Am. J. Sports Med., 1997, 25, 54-58.
19. Lentell G., Katzman L., Walters M. The relationship between muscle function and ankle stability. J. Orthop. Sports Phys. Ther., 1991, 11, 605-611.
20. Lephart S., Pincivero D., Giraldo J., Fu F. The role of proprioception in the management and rehabilitation of athletic injuries. Am. J. Sports Med., 1997, 25, 130-137.
21. Löfvenberg R., Kärrholm J., Sundelin G., Ahlgren O. Prolonged reaction time in patients with chronic lateral instability of the ankle. Am. J. Sports Med., 1995, 23, 414-417.
22. Miller E., Hergenroeder A. Prophylactic ankle bracing. Pediatr. Clin. North Am., 1990, 37, 1175-85.
23. Nawoczenski D., Owen M., Ecker M., Altman B., Epler M. Objective evaluation of peroneal response to sudden inversion stress. J. Orthop. Sports Phys. Ther., 1985, 7, 107-109.
24. Nederlandse huisartsenstandaard enkeldistorsie. In : Van Dijk C., On diagnostic strategies in patients with severe ankle sprain. Thesis, Vrije Universiteit Amsterdam, 1994.
25. Noyes F. R. Functional properties of knee ligaments and alterations induced by immobilisation. Clin. Orthop., 1977, 123, 210-224.
26. Rasmussen O. Stability of the ankle joint. Acta Orthop. Scand., 1985, 56.
27. Scheuffelen C., Gollhofer A., Lohrer H. Neuartige funktionelle Untersuchungen zum Stabilisierungsverhalten von Sprunggelenksorthesen. Sportverl. Sportschad., 1993, 7, 30-36.
28. Scheuffelen C., Rapp M., Gollhofer A., Lohrer H. Orthotic devices in functional treatment of ankle sprain. Stabilizing effects during real movements. Int. J. Sports Med., 1993, 14, 140-149.
29. Sommer H., Arza D. Functional treatment of recent ruptures of the fibular ligament of the ankle. Int. Orthop., 1989, 13, 157-160.
30. Stiell I., McKnight R., Greenberg G., McDowell I., Nair R., Wells G., Johns C., Worthington J. Implementation of the Ottawa ankle rules, JAMA, 1994, 271, 827-832.
31. Tiling T., Bonk A., Höher, Klein J. Die Akuten Aussenbandverletzung des Spruinggelenks beim Sportler. Der Chirurg, 1994, 65, 920-933.
32. Tropp H. Functional instability of the ankle joint. Thesis, 1985. Linköping University.
33. Vaes P., De Boeck H., Handelberg F., Opdecam P. Comparative radiological study of the influence of ankle joint bandages on ankle stability, Acta Orthop Belg., 1984, 50, 636-644.
34. Vaes P. H., Handelberg F., Shahabpour M. Correct spatial angle determination using MRI. Conference proceedings, EFORT München, July 1995 (abstract). J. Bone Joint Surg., 1995, 77-B (Proceedings).
35. Vaes P., Van Gheluwe B., Antone T. Accelerometric and EMG evaluations of simulated ankle sprain. Conference proceedings, EFORT Barcelona, April 1997.
36. Vaes P., Duquet W., Handelberg F., Casteleyn P. P., Opdecam P. Static and dynamic Roentgen analysis of ankle stability in braced and non-braced normal and functional unstable ankles. Am. J. Sports Med., in press.
37. Vaes P., Handelberg F., Duquet W. Supine versus erect ankle stress Roentgen procedure in functionally unstable ankles. EFORT, Barcelona, April 1997 (abstract). J. Bone Joint Surg., 1977, 79-B (Proceedings).
38. Vanhoutte J. Onderzoek van het distorsiemechanisme tijdens een gesimuleerde enkelverzwikking, met en zonder tape/brace, thesis, Vrije Universiteit Brussel, Belgium, 1997.
39. Yamamoto T., Kigawa A., Xu T. Effectiveness of functional ankle taping for judo athletes, a comparison between judo bandaging and taping. Br. J. Sports Med., 1993, 27, 110-112.

SAMENVATTING

P. VAES, W. DUQUET, F. HANDELBERG, P.-P. CASTELEYN, R. VAN TIGGELEN, P. OPDECAM. Objectieve radiologische meetingen van de invloed van braces op de pathologische enkelmobiliteit.

Er werd een onderzoek uitgevoerd van de invloed van tape bandage en 9 verschillende braces op talusrotatie. Bij 220 instabiele enkels werd een gestandaardiseerd en EMG gecontroleerd Röntgen stress onderzoek toegepast. De talus rotatie (TT) werd gemeten zonder externe steun en vervolgens vergeleken met de TT gemeten met tape/brace. De resultaten van het onderzoek tonen aan dat, op basis van de mechanische invloed, een onderverdeling kan gemaakt worden in verschillende stabilisatieklassen van enkelorthesen. De tape bandage en 2 braces veroorzaakten een hoog significante afname van de TT. De gemiddelde TT zonder steun werd met tape verminderd van 13.4° tot 4.9°, met braces respectievelijk tot 4.8° en 5.9. Naast twee andere braces die de TT significant maar in beperkte mate verminderden werd bij 5 braces geen significante invloed op de TT gevonden. Het is aan te bevelen de stabilisatie door braces te onderzoeken voorafgaand aan het toepassen na een acute distorsie of bij chronische instabiliteit.

RÉSUMÉ

P. VAES, W. DUQUET, F. HANDELBERG, P.-P. CASTELEYN, R. VAN TIGGELEN, P. OPDECAM. Mesure radiologique objective de l'influence des orthèses de la cheville sur la mobilité pathologique.

La stabilisation procurée par le taping et par 9 orthèses de cheville a été testée dans 220 chevilles fonctionnellement instables. Un stress radiologique standardisé, contrôlé par EMG a été utilisé pour mesurer la bascule astragalienne (TT) dans les conditions suivantes : sans contention, avec taping, et avec orthèse. Différents niveaux de stabilisation ont pu être identifiés. Le taping et 2 orthèses avaient une influence hautement significative sur la bascule astragalienne. Le TT moyen sans contention a été réduit de 13,4° à 4,9° par le taping, et respectivement à 4,8° et à 5,9° par deux orthèses. Deux autres orthèses montraient une influence significative mais limitée et 5 orthèses n'avaient aucune influence significative sur la bascule astragalienne. La qualité de la protection offerte par les bandages et orthèses devrait être connue avant d'utiliser ce genre de contention externe comme moyen de traitement d'une entorse aiguë ou comme protection fiable dans la vie courante et dans la pratique du sport.