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Title
Structuring the complex relation between foot pathologies and insole design - for the benefit of clinical practice and scientific research

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Summary
Studies and clinical practice typically try to link a foot pathology one-to-one to insole design, underestimating the influence of symptoms, risks and properties (‘features’). We propose to rather link features to insole design, which might just be the clue to find out if, when and how insoles work.

Introduction
Today, the clinical practice of insole design is for a big part experience-based due to lacking scientific evidence. Studies are plenty but lack common language,details about the patient groups, and details about the insole designs, and they aim to find one insole to cover an entire pathology. This oversimplifying of the pathology-insole relationship is a problem for good results [1,2,3].

After all, several possible insole concepts exist for one pathology, since an insole design is also dependent on a lot of other factors such as the specific symptoms the patient has, foot type and gait pattern. The combination of all these features determine if a certain insole design will work or not.

There is a need to clarify and structure this complex pathology-insole relationship, for benefit of research and clinical practice. The aim of this study is to create a bridge between the pathology with all its different appearances on the one hand, and the appropriate insole concepts on the other hand.

Methods

We consider 27 foot pathologies treatable with insoles [4]. Firstly, for reasons of clarity, associated symptoms, risks and properties (called the ‘features’ of the pathology) are divided into different categories: pain, inflammations, deformations, gait patterns, standing position, mobility, soft tissue, personal characteristics, muscle and joint abnormalities, activities, systemic diseases, and others.

Secondly, possible insole concepts, are documented and linked to the specific dominant feature it solves. The insole concept is the goal for which the insole is designed. This includes amongst others, motion control, supporting a weak area, unloading a painful spot, and cushioning a sensitive part. These links are fetched from literature and Belgian common practice.

Finally, the practical implementations for each insole concept (insole design), is documented.

We put all the information in a relational database, were we can extract necessary aspects for different applications [Fig 1].

Results

We created a bridge between all the features of a pathology and the appropriate insole concepts. Two examples demonstrate the clarity this method can bring for insole design:

For plantar fasciitis, insole effectiveness is proven but ideas about designs are contradictory[5,6,7]. Considering different features of plantar fasciitis, the optimal insole design becomes more clear: A plantar fasciitis with flexible pes planus (risk) should use an insole concept for pronation control to take away the cause of the inflammation. The associated insole design utilize an arch support. A plantar fasciitis with a dominant heel pain (symptom) should use a concept for pain reduction, by redistributing the pressure e.g. by softening the hindfoot part. Both insole concepts can be combined when both features are present.

Hallux limitus is a pathology with recommended insole treatment but poor evidence [8]. Considering features related to the pathology, interesting insole concepts come up. A hallux limitus with dominant pain feeling, can use an insole concept to adapt the hallux dorsiflexion. This can be implemented using an arch support design. A hallux limitus that shows osteoarthritis, should use an insole concept to limit the motion using rigid part under the first ray.

We clarified relations for 27 pathologies, which define over 200 features and get linked to plenty different insole concepts and their practical designs. We are continuous completing and improving the data and the relations.

Conclusion

Foot insoles have been proposed the last decades as solution to different foot pathologies. Their use in clinical practice is growing, as are scientific studies about their design and effectiveness. Studies are abundant but lack common language, details about the patient groups, details about the insole designs, and aim to find one insole to cover an entire pathology [1].

However, insoles do not serve a solution for a pathology: insoles serve a certain concept, which can be amongst others changing a motion pattern (in the foot or higher in the kinetic chain), changing muscle activation, unloading a certain painful spot, supporting a weak area, reducing impact forces. Each insole concept helps with a (group of) feature(s) that the patient is affected with. Such features can be for example pain in the heel, inflammation of a tendon, an unusual long metatarsal, a bouncy gait pattern, a pronated stance position, hyperflexibility, a cyst, the patients' age, a dysfunctional muscle, a high frequency of running, a diabetes patient, previous trauma. The dominant features of the patient always determine the insole concept.

Though it stays important to diagnose the pathology, we should start to think in a features-insole relation rather than a pathology-insole relation. This might be just the clue to solve big questions like 'Why do insoles work?', and continuous discussions between clinicians about 'What insole design should be used?'.

References

[1] K. Mills, P.Blanch, A.R.Chapman, T.G.McPoil, B.Vicenzino, "Foot orthoses and gait: a systematic review and meta-analysis of literature pertaining to potential mechanisms", Br J Sports Med 2010

[2] B.M. Nigg, "The Role of Impact Forces and Foot Pronation: A New Paradigm", Clinical Journal of Sport Medicine, 2001

[3] B.M. Nigg, J.Baltich, S. Hoerzer, et al, “Running shoes and running injuries: mythbusting and a proposal for two new paradigms: ‘preferred movement path’ and ‘comfort filter’”, Br J Sports Med Published 2015

[4] M. Bernard, H. Goldsmith, K. Gurnick, and B. Jarret, “Prescription of custom foot orthoses practice guidelines,” Am. Coll. Foot Ankle Orthop. Med., 2006.

[5] R.L. Martin, et al, “Heel Pain—Plantar Fasciitis: Revision 2014 - Clinical Practice Guidelines Linked to the International Classification of Functioning, Disability and Health From the Orthopaedic Section of the American Physical Therapy Association”, J Orthop Sports Phys Ther. 2014

[6] P.Hume, W. Hopkins, K.Rome, P.Maulder, G. Coyle, B.Nigg, “Effectiveness of Foot Orthoses for Treatment and Prevention of Lower Limb Injuries”, Sports Med 2008

[7] R.A.Werner, et al, “Risk Factors for Foot and Ankle Disorders Among Assembly Plant Workers”, Am. Journal of industrial medicine, 2010

[8] C.K.K.King, et al, “Comprehensive Review of Non-Operative Management of Hallux Rigidus”, Cureus 2017

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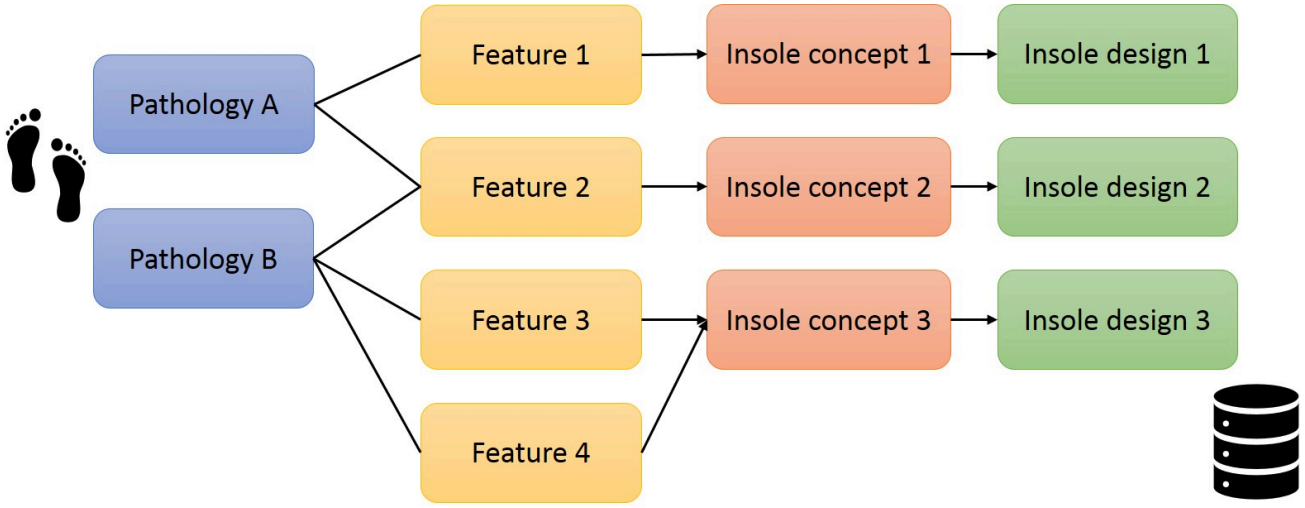

Fig 1: Organized and related data linking pathology and insole design