

Knowledge transfer helps create better design solutions

Case Study: Hinged Knee Brace (2007)



Introduction

In June 2007, we welcomed a new intern designer to our Beijing studio. Edwina Lawson came from Melbourne in Australia, and was a final year undergraduate studying product design at the University of Newcastle. The moment we first met at Beijing airport, we saw she was very curious about everything to do with China. We were impressed by her vitality and enthusiasm. In conversation, we learnt that she had just been caught up in some of the worst flooding and storms in Melbourne's history - storm conditions that made international news and saw many people trapped and injured. Edwina showed us pictures of her flooded car, plus she described how the experience affected her and led to a bad knee injury. During our discussion she explained how most knee supports were not helping her, and that she hoped to somehow find a better solution to speed up her rehabilitation. Tony Zhong, director of PER Design (China), was so interested in Edwina's story that he proposed making it her internship project, with full access to our staff and resources. Needless to say Edwina jumped at the chance.

Brief

The project required Edwina to design a support brace for the treatment of knee ligament injuries and cartilage tears. The specific design requirements were to create a solution that a) didn't loosen or slip down the leg during motion - common in many other products, b) supports the knee in the correct position at all times, c) was comfortable to wear over long periods even in a hot climate, and d) allowed the knee or leg to bend without restriction. And of course it also needed to be usable (easy to put on and remove), distinct (something genuinely new), desirable (less of a rehabilitation aid and more a fashion accessory with a medical purpose), and producible (using existing cost-effective materials and techniques). Edwina's industrial design skills, together with our own, meant we had every chance of finding a good solution.

Activity

We assigned 2 industrial designers and 1 mechanical engineer to work with Edwina on this project. It's not uncommon for us to do in-house projects like this, particularly if we feel an idea has merit or can widen the experience of our staff.

The team's first priority was to find an air-permeable elastic material that not only held firm on the leg, but also one that prevented sweat absorption and skin irritation. We sourced a suitable material, but tests showed that elastic compression alone was not enough to hold it in position as the muscles on human thighs and calves would constantly contract and move. It was clear we needed some other dynamic fixation to assist the elastic material. Through discussions exploring many different fixing methods, we found the perfect solution in an unlikely place.

Ski boots use a system whereby the steel cable lace ends are fixed to a spool within a miniature reel. When the knob is rotated, the lace is wound onto the spool and the boot tightens. The gear train in the reel develops significant mechanical advantage, so a great deal of tensioning force is created with very little effort. For Edwina's project, integrating this facility with the permeable elastic fabric was a rational option. The fine teeth on the spool allowed the

user to adjust the tightness of the elastic support according to muscle movements.

Identifying where and how to attach the hinged mechanical brace members to the thigh was a big technical challenge in this project, mainly because the form of a human thigh is almost cone shaped. Using mock-ups to refine the optimal hinge point and general fit to either side of the leg, we then worked out how to build the spooling mechanism into the braces. Edwina and our engineer then detailed this design fully in CAD, modelling movements and analysing the integrity of the structure under different loading conditions. The result was a pair of attractive hinged braces that were light, durable, and gave the desired support to the knee joint. It took one week to make a final prototype.

Results

The project took nearly 6 weeks to complete, and covered a wide range of areas like advanced materials and mechanical design engineering. Edwina proudly tested the prototype, wearing it almost full time for a number of weeks, and concluded it was a great success. It met all the objectives she laid out at the start, and she certainly felt it helped in the speedier rehabilitation of her knee injury. The device was not designed for a commercial client, but it was treated as a serious commercial design project. It's not yet on the market, but both PER Design and Edwina are exploring licensing opportunities with established companies in the general orthopaedic therapy device sector.

Here's what Edwina had to say about working with PER Design:

"I completed my internship with PER Design and Consultants in 2007 during my final honors year at the University of Newcastle, Australia. These internships are lucrative and competitive and also require the intern to relocate to Beijing for its duration.

The experience that I had with PER Design was invaluable. It provided me with a well rounded perspective in industrial design and manufacturing, as well as first hand experience in an internationally competitive design consultancy. Furthermore it gave me an insight into Chinese culture, which is a valuable commodity considering the level of production and manufacturing which occurs in China today.

During the time in Beijing I developed an excellent rapport with Rong Zhong - the company director who's professionalism, initiative and forethought drives the company to continually push new boundaries. I believe this connection in itself will lead to future opportunities.

Once graduating I was armed with the experience and understanding to make me a highly competitive graduate. This competitive edge enabled me to gain employment with Design+Industry (www.design-industry.com.au), Australia's largest and leading Industrial Design consultancy.

Rong Zhong and his team at PER Design have my eternal gratitude for providing me with a launching pad for my career. I have no hesitation in commending PER Design to any organisation or individual that might be considering engaging them."

**Edwina Lawson
BDes Ind (Hons)**

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