

Research Evidence of the Benefits of the Natural-Fit Handrim

The Natural-Fit is one of the most extensively researched wheelchair handrims. One of the studies that tested the Natural-Fit was funded by the National Institutes of Health (NIH) through their Small Business Innovation Research (SBIR) program (Grant #R43 HD39962-01). And, more recently, a survey of Natural-Fit Handrim users was conducted to examine self-reported outcomes of using the handrim. Both of these studies are summarized below.

End-User Survey

- Survey was done as part of an NIH grant proposal and was designed by an expert in survey research.
- 90 surveys were mailed out to users of the Natural-Fit Handrim; 46 completed surveys were returned; all responses were anonymous
- Respondents on average had used Natural-Fit Handrims on their wheelchairs for 25 weeks.
- When asked to compare propelling with the Natural-Fit to propelling with their prior handrims,
 - 85% reported less fatigue
 - 80% reported less pain in their wrists
 - 65% reported less pain in their shoulders
 - 93% said it was better than a standard rim

If you would like a more detailed summary of the End-User Survey, please go to the following page on our web site: [http://www.3rivers.com/PDF/Natural-Fit End-User Survey 7-2004.pdf](http://www.3rivers.com/PDF/Natural-Fit%20End-User%20Survey%207-2004.pdf)

NIH-Funded Research: The Effect on Wheelchair Propulsion Biomechanics

- The National Institutes of Health (NIH) funded research comparing wheelchair propulsion efficiency when using the Natural-Fit versus using a standard handrim.
- In the NIH study, a prototype Natural-Fit Handrim was used during a two-week trial period with before and after measurements of propulsion efficiency.
- After the two-week trial use period, wheelchair users generated significantly more (7%) forward force with the Natural-Fit than with a standard handrim.
 - The increased forward force created no significant difference in overall total forces between the two handrims.
 - This is the best indication of a more efficient, healthier propulsion stroke with the Natural-Fit Handrim.

If you would like a more detailed summary of the End-User Survey, please go to the following page on our web site: [http://www.3rivers.com/PDF/Natural-Fit Phase I Final Report Abstract.pdf](http://www.3rivers.com/PDF/Natural-Fit%20Phase%20I%20Final%20Report%20Abstract.pdf)

The Natural-Fit Handrim

End-User Survey

Overview and Survey Design

The Natural-Fit Handrim reduces stress on the hands, wrists, and arms through improved propulsion and braking efficiency (i.e., less wasted energy, better control, and no burning of the hands). This, in turn, should help to reduce the incidence of fatigue, pain, and injury that is common among manual wheelchair users. As a preliminary test of this assertion, we surveyed users of the Natural-Fit Handrim (the complete text of the survey is attached to this report). These were manual wheelchair users who replaced their standard handrim with the Natural-Fit. To this group of end-users (n=90), we mailed out a survey in late June, 2004 and requested that surveys be returned by July 12, 2004. In return for completing and mailing back the survey, end-users were entered into a drawing to win one of three cash prizes, \$150, \$75, and \$25. To insure anonymity, they were told in a cover letter:

“Your responses to the survey will be completely anonymous. Please do not put your name on the survey. However, to insure your entry into the drawing for the cash prizes, each person has been assigned a code number (which is on the bottom of the second page of the survey). This code number will be removed from the survey upon receipt and placed separately in the drawing – leaving the survey without any identification.”

We received 46 (37 males and 9 females) surveys in return, a 51% response rate. Even with the incentive of the drawing, this is an unusually high response rate.

Results

The results of the survey are summarized in *Table 1*. All the questions reported in *Table 1* were on 5-point scales and were in the context of comparing end-users' propulsion experience with the Natural-Fit to their experience with their prior standard handrims. Average duration of use of the Natural-Fit was 25 weeks, with a range of 2 to 64 weeks, and with 85% of respondents at 10 weeks or more.

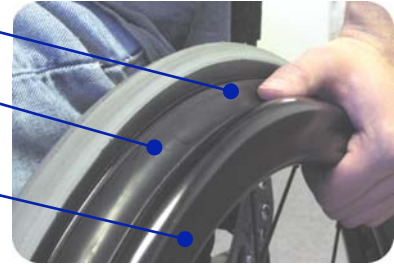
The survey results strongly confirmed the expected reduction in fatigue and pain. When asked to compare propelling with the Natural-Fit to propelling with their prior handrims, 85% of respondents reported feeling less fatigue with the Natural-Fit, 85% reported less pain in their hands, 80% reported less pain in their wrists, and 66% reported less pain in their shoulders. Because the Natural-Fit eliminates the need to grab the tire (rated as an important feature by 83% of the respondents), it also keeps hands cleaner and reduces the likelihood of calluses, abrasions, and infections. These are just a few examples of the results in *Table 1*. Taken together, these results are compelling. They suggest that using the Natural-Fit will help to facilitate outcomes for wheelchair users that will serve to: 1) Enhance quality of life, 2) Avoid medical costs associated with the treatment of pain and injury, and 3) Extend ability to remain in a manual wheelchair, which also avoids costs associated with the prescription of a power wheelchair.

In addition to the questions contained in *Table 1*, the results from two other questions are noteworthy. In response to a question on whether the Natural-Fit was better or worse than a standard wheelchair handrim, 93% of the respondents said it was better (80% said “much better” and 13% said “somewhat better”). In another question, end-users were asked: “If someone were to offer you money to switch back from Natural-Fit Handrims to standard wheelchair handrims, how much money would it

Contoured slot for the thumb
improves grip and safety

Friction coating only on
propulsion surface

Expanded smooth surface for
braking without burning



The Natural-Fit Handrim

take?” Response options ranged from \$1 up to \$500 (by \$100 increments) and an option, “I would never switch back.” The most common response was this latter option: 76% of respondents said they would never switch back. Another 11% said they would switch back for \$500, and just 13% said they would switch back for less than \$500.

Table 1: Responses to Early Adopter End-User Survey (n=46)

| Question and Percent (%) for Each Option and Overall Mean | Much Less | Somewhat Less | About the Same | Somewhat More | Much More | Mean (1=less 5=more) |
|--|-----------|---------------|----------------|---------------|-----------|-----------------------------------|
| Is propelling more or less comfortable ... | 2.2 | 2.2 | 0.0 | 26.1 | 69.6 | 4.59 |
| Is propelling more or less fatiguing ... | 52.2 | 32.6 | 8.7 | 6.5 | 0.0 | 1.69 |
| Is propelling more or less difficult ... | 60.9 | 30.4 | 4.3 | 4.3 | 0.0 | 1.52 |
| More or less pain in your hands... | 60.9 | 23.9 | 13.0 | 0.0 | 2.2 | 1.59 |
| More or less pain in your wrists... | 52.2 | 28.3 | 17.4 | 0.0 | 2.2 | 1.72 |
| More or less pain in your shoulders... | 29.5 | 36.4 | 29.5 | 4.5 | 0.0 | 2.09 |
| More or less numbness in your hands... | 42.9 | 35.7 | 21.4 | 0.0 | 0.0 | 1.78 |
| More or less numbness in your wrists... | 38.1 | 23.8 | 38.1 | 0.0 | 0.0 | 2.00 |
| More or less numbness in your shoulders... | 33.3 | 19.0 | 47.6 | 0.0 | 0.0 | 2.14 |
| More or less tingling in your hands... | 46.3 | 34.1 | 19.5 | 0.0 | 0.0 | 1.73 |
| More or less tingling in your wrists... | 41.5 | 22.0 | 36.6 | 0.0 | 0.0 | 1.95 |
| More or less tingling in your shoulders... | 29.3 | 24.4 | 43.9 | 2.4 | 0.0 | 2.19 |
| Ease of other ADLs (more or less easy) | 2.2 | 4.3 | 50.0 | 32.6 | 10.9 | 3.46 |
| Opinion of the Natural-Fit (more or less favorable) | 4.3 | 0.0 | 0.0 | 17.4 | 78.3 | 4.91 |

There are some alternative explanations for these results. Because the survey is not based on a random sample, one may argue that only those with favorable opinions decided to respond. Or perhaps end-users thought they might have a better chance to win the drawing if they responded favorably. And, of course, these data are based on subjective self-reports. While these are important shortcomings of the survey, we do not think that they invalidate the results. First, offering the drawing as incentive should reduce the likelihood that only those who are satisfied with the handrim would respond. Second, because responses were clearly made to be anonymous, it is unlikely that respondents thought that they had to be “positive to win”. Third, not all responses were positive: Respondents showed clear discrimination among the questions. For example, one question asked whether using the Natural-Fit made other activities of daily living easier, activities that don’t involve propulsion such as writing, bathing, and dressing. Here the modal response was “About the Same” with a mean (3.46) just slightly leaning toward “easier” perhaps because there is a spill over effect of having your hands, wrists, and shoulders less stressed during propulsion. Thus, we believe the validity of these results is high.

Summary

The responses to this survey were based on *extensive use* with the Natural-Fit Handrim – in most cases over 2½ months and with an average duration of use of 6 months! These results indicate extremely high levels of satisfaction with the Natural-Fit, and a decided unwillingness to switch back to a standard handrim. Most importantly, self-reports of end-users indicated reductions in fatigue and pain in the hands, wrists, and shoulders when propelling with the Natural-Fit. This is a clear testament to benefits of the Natural-Fit Handrim.

For questions about this research, please write to David S. Boninger, Ph.D. at david@3rivers.com.

The Natural-Fit Handrim Feedback Survey

Please tell it like it is – we want your honest opinion of the Natural-Fit Handrim. Only through your forthright responses can we make it better.

As you know, fatigue and pain in the hand, wrist, and shoulder are sometimes common among people using manual wheelchairs. The purpose of this survey is to get an idea of **your** comfort, fatigue and pain **before** and **after** using *Natural-Fit Handrims*. We will also ask several questions about your overall opinion of the *Natural-Fit Handrim*.

1) Have the *Natural-Fit Handrims* made propelling your wheelchair more or less comfortable than when using your prior handrims?

- Much Less Comfortable
 Somewhat Less Comfortable
 About the same
 Somewhat More Comfortable
 Much More Comfortable

2) Is propelling your wheelchair more or less fatiguing when using *Natural-Fit Handrims* than when using your prior handrims?

- Much Less Fatiguing
 Somewhat Less Fatiguing
 About the same
 Somewhat More Fatiguing
 Much More Fatiguing

3) Do you think *Natural-Fit Handrims* make it more or less difficult to propel your wheelchair?

- Much Less Difficult
 Somewhat Less Difficult
 About the same
 Somewhat More Difficult
 Much More Difficult

4) Please rate each of the questions below by **circling one number** that best describes your experience or opinion. The scale to use is as follows:

1 = Much less 2 = Somewhat less 3 = About the same 4 = Somewhat more 5 = Much more

| | | | | | |
|--|---|---|---|---|---|
| Do you feel more or less pain in your hands when using <i>Natural-Fit Handrims</i> than when using your prior handrims? | 1 | 2 | 3 | 4 | 5 |
| Do you feel more or less pain in your wrists when using <i>Natural-Fit Handrims</i> than when using your prior handrims? | 1 | 2 | 3 | 4 | 5 |
| Do you feel more or less pain in your shoulders when using <i>Natural-Fit Handrims</i> than when using your prior handrims? | 1 | 2 | 3 | 4 | 5 |
| Do you feel more or less numbness in your hands when using <i>Natural-Fit Handrims</i> than when using your prior handrims? | 1 | 2 | 3 | 4 | 5 |
| Do you feel more or less numbness in your wrists when using <i>Natural-Fit Handrims</i> than when using your prior handrims? | 1 | 2 | 3 | 4 | 5 |
| Do you feel more or less numbness in your shoulders when using <i>Natural-Fit Handrims</i> than when using your prior handrims? | 1 | 2 | 3 | 4 | 5 |
| Do you feel more or less tingling in your hands when using <i>Natural-Fit Handrims</i> than when using your prior handrims? | 1 | 2 | 3 | 4 | 5 |
| Do you feel more or less tingling in your wrists when using <i>Natural-Fit Handrims</i> than when using your prior handrims? | 1 | 2 | 3 | 4 | 5 |
| Do you feel more or less tingling in your shoulders when using <i>Natural-Fit Handrims</i> than when using your prior handrims? | 1 | 2 | 3 | 4 | 5 |

5) How your hands, wrists, and shoulders feel may impact other activities you do on a daily basis. Have daily activities (e.g. writing, bathing and dressing) become harder or easier since using *Natural-Fit Handrims*?

- Definitely Not Easier Probably Not Easier About the same Easier Much Easier

6) The Natural-Fit Handrim has a variety of features. We are interested in how important each of these features is to you personally. Please rate each of the features below by **circling one number** that best describes your experience or opinion. The scale to use is as follows:

1 = Not at all important 2 = Not very important 3 = About the same 4 = Somewhat important 5 = Very important

| | | | | | |
|---|---|---|---|---|---|
| Ergonomic fit to the hand | 1 | 2 | 3 | 4 | 5 |
| Larger smooth surface for braking | 1 | 2 | 3 | 4 | 5 |
| Added grip provided by coating of the thumb piece | 1 | 2 | 3 | 4 | 5 |
| Thumb piece for a larger propulsion surface | 1 | 2 | 3 | 4 | 5 |
| No gap between the rim and wheel | 1 | 2 | 3 | 4 | 5 |
| Removes the need to push on the wheelchair tires | 1 | 2 | 3 | 4 | 5 |
| Hygiene of hands improved | 1 | 2 | 3 | 4 | 5 |
| Retrofits to existing wheels of wheelchair | 1 | 2 | 3 | 4 | 5 |

7) What is your overall opinion of the *Natural-Fit Handrim*?

- Very Unfavorable Somewhat Unfavorable Neutral Somewhat Favorable Very Favorable

8) Do you think that the *Natural-Fit* is better or worse than a standard wheelchair handrim?

- Much Worse Somewhat Worse Neutral Somewhat Better Much Better

9) If someone were to offer you money to switch back from *Natural-Fit Handrims* to standard wheelchair handrims, how much money would it take?

- \$1 \$100 \$200 \$300 \$400 \$500 I would never switch back

10) Who installed your *Natural-Fit Handrims*?

- I did A dealer A clinic A friend or family member

11) How easy or difficult was the installation of your *Natural-Fit Handrims*?

- Extremely Easy Somewhat Easy Neutral Somewhat Difficult Extremely Difficult

12) Is there anything about the *Natural-Fit* that you would change if you could? Please explain your answer.

13) What are the features of the *Natural-Fit* that you like best? Please explain your answer.

Thank you very much for your time!! Now please return the survey in the addressed, stamped envelope so that we can enter you in the cash prize drawing.

Your code is [[Survey #]]!!