

1. What is the tool and what is it used for?

Nut keys also known as nut picks are slender pieces of metal which allow climbers to reach deep into cracks to dislodge stuck or jammed equipment, primarily nuts.

2. Annotated Images of User Interaction and Problems





As tool is placed into crack it forces wrist flexion at uncomfortable angle, outside of neutral position

Fingers also run into sides of crack creating pressure while trying to get tool deep into crack

Further tissue compression along metal edges of tool as tool is pushed into the crack





To reach very deep into cracks, fingers are forced into insecure and uncomfortable pinch position



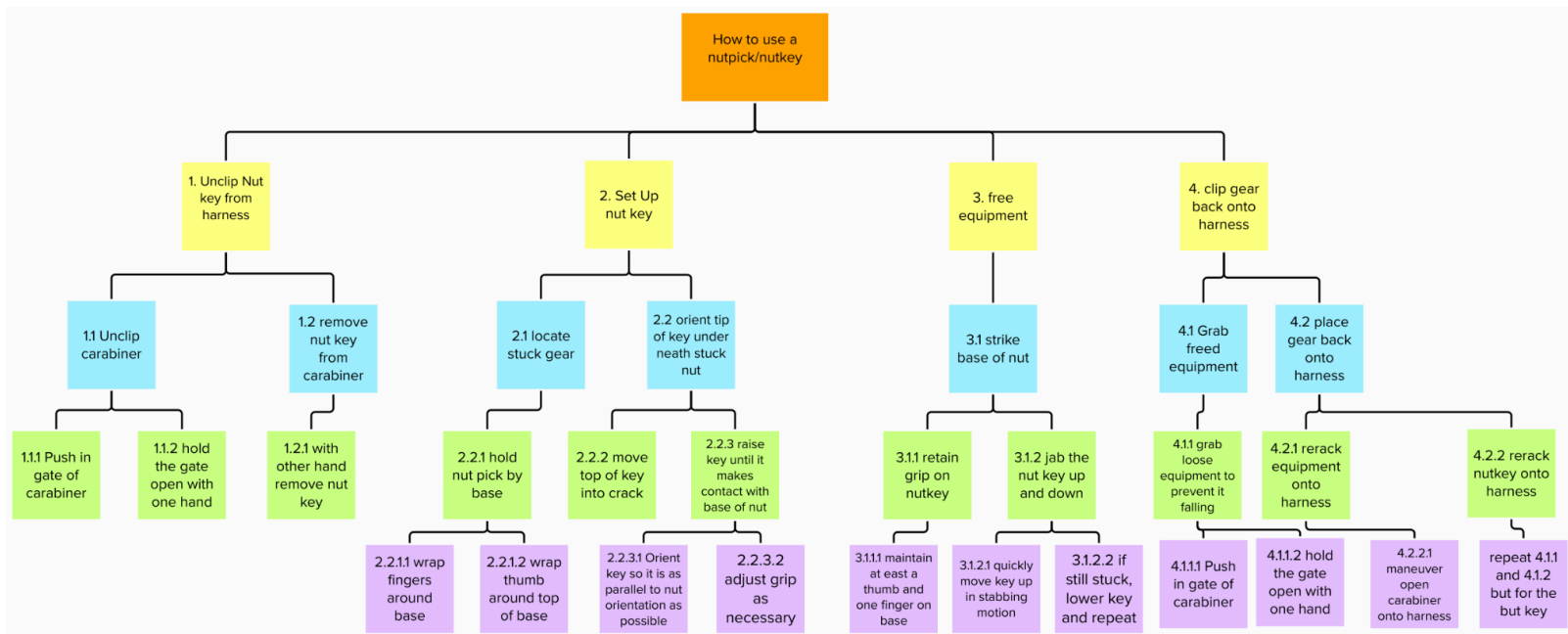
Wrist flexion is forced even further from neutral position when pushed deep into crack

Less contact between fingers and tool creates more focused tissue compression points



When using the tool wrist is forced out of neutral position into abduction

3. Hierarchical Analysis



Link to video:

https://drive.google.com/file/d/1OoQGN4_xA9-xi1v3lRJoJsizqma5vsdD/view?usp=sharing

4. Anthropometric Features Table

Task	SubTask	Relevant Physical Product Features	Relevant Body parts and Postures	Anthropometrics Dimensions (mm) All 50th percentile	%ile range chosen	Rationale
Set Up Nut Key	2.2.1 Hold Nut pick by base	Grip width	Fingers, palm Tissue Compression	Maximum grip diameter M - 52 W-48 SD: M-4 W-3	95	All climbers with varying hand sizes should be able to grip key comfortably
		Handle length	Hand	Hand Breadth (metacarpal) M - 87 W - 76 SD: M-5 W-4	95	Since the grip can be held anywhere along its length, the key should be long to make deep and high reaches
		Nut Key thickness	Fingers Tissue Compression	Pinch Grip (forward grip reach) M - 40 W - 35 For fingertip operation M - 115 W - 105 Hand thickness(including thumb) M - 51 W - 45 SD: M-4 W-3	95th " 95th	Everyone of varying hand sizes should be able to pinch the key comfortable " Largest hands will have the most trouble squeezing the tool into a deep crack, so they should be accounted for when determining tool thickness

	2.2 Orient tip of key underneath stuck nut	Tool shape	Wrist	<p>Wrist flexion M/W - 90 SD: 12</p> <p>Wrist Extension M/W - 99 SD: 13</p> <p>Elbow flexion M/W - 142 SD: 10</p>	<p>5th</p> <p>“</p> <p>50th</p>	<p>People with bad wrist mobility will have the hardest time rotating their wrist into a deep crack</p> <p>“</p> <p>Too angled, keeps from a deeper reach into cracks, Too straight doesn't allow for more adaptable use</p>
		Length of Tool (total length)	Shoulder (reach)	<p>Vertical grip reach (standing) M - 2060 W - 2020 SD: M - 80 W - 71</p> <p>Shoulder-grip length M - 665 W - 600 SD: M-32 W - 29</p> <p>Shoulder Flexion M/W - 188 SD: 12</p> <p>Shoulder abduction M/W - 134 SD : 17</p>	<p>5th</p> <p>“</p> <p>5th</p>	<p>People with limited reach will have the hardest time reaching and retrieving equipment</p> <p>“</p> <p>Shoulder mobility injuries and problems are common among climbers and those with limited shoulder mobility should still be able to reach</p>

						equipment
Free Equipment	3.1.1 retain grip on nut key	Handle width	Fingers, hand	Grip Strength M - 40.31 kgs W - 23.78 lbs SD: M-6.16 W-4.18	50th	Grip strength is relatively high amongst climbers, but varying strength people should be able to retain control over the tool while in use
	3.1.2 jab the nut key up and down	Tool angle, length	Wrist Elbow	Wrist Abduction (radial deviation) M/W - 27 SD - 9 Shoulder flexion Shoulder Flexion M/W - 188 SD: 12 Elbow flexion M/W - 142 SD: 10	50th 5th 50th	Climbers should have decent wrist mobility and all should be able to operate the key comfortably Shoulder mobility is a common problem amongst climbers and will have harder times flexing their shoulder to use the too All users should be able to use the tool without compromising its strength and rigidity

