Best Practices in Knife Sharpening and Handling

Peter Dowd
Founder & Principal Consultant
Anago Limited
peter.dowd@anagosharp.com
Background

• Live in New Zealand with my wife and 2 sons

• Extensive experience
  - injury prevention
  - processing efficiency
  - food products, IT, building products, low and high tech

• Strong history with the global meat industry
  - leadership of New Zealand Meat Industry National Health & Safety Forum (meat & seafood)
  - leadership of a wide range of projects (knife sterilization, pituitary gland extraction, knife sharpness, injury data analysis, new beef jerky products…)
  - world-first innovations (reduction in sprain/strain injuries from chain mail gloves, edge sharpness and roughness measurement)
  - collation and analysis of national injury data in New Zealand, ultimately leading to anagoSafe.com
  - global exports (Americas, Australasia, Europe, Asia)
  - wide range of meat industry R&D projects

• 20 years of applied research into what makes a sharp knife
What I call a [good] knife

Sharp
  • at least 8.0

Safe
  • up to 80% drop in injuries

Fast
  • up to 30% faster

Accurate
  • fewer errors, rework and low value trim
What we will cover

The impact of a sharp knife
- Health & Safety & Productivity

Theory of sharpness
- Grinding, Honing, Steeling

Best practice sharpening methods & systems
- External, Internal, Centralized, Individualized

Best practice handling of knives in use
- Knife hand, Non-knife hand
Muscular Skeletal Injuries: Key Risk Factors

Effort
- force
- moment

Recovery
- duration
- repetition

Health
- vascular efficiency
  - gradual damage leads to a viscous spiral
Injury Prevention Investment

The single biggest barrier to investment?

Negative impact on profits
- Increase costs (equipment, training…)
- Slower production

NOT always real

But almost always PERCEIVED
Cutting Force Comparisons

Cutting with Sharp vs. Dull Blades

- 4x – 6x peak force
- 15% slower (1.5 sec)
Bull vs. Cow vs. Steer

Grip and Cut Force

Force (kgF)

Cow  Bull  Steer

1 1001 2001 3001 4001 5001
So what about sharpness?

Substandard sharpness causes

• increased grip forces and moments
• insufficient opportunity for recovery (need more, but get less)
• reduced vascular efficiency from higher grip forces (try it)

Suitably sharp knives enable

• faster processing (less time per cut, less waiting for slower team members - the whole team speeds up)
• increased quality (increased accuracy of cutting, greater focus on technique)
• increased yield (absolute yield, effective yield, greater % of product on higher value specifications)
Proven Impact on H&S and Production

Global Processor

• Reduced effort by over 80%
• Reduced discomfort levels to almost nothing
• Increased productivity
  • Same line staff
  • Same throughput
  • Higher value product with 30% more cuts per minute

Drastic improvements to **both** Health & Safety and Production measures

• unexpected lesson:
  • people suffer a lot of pain, even when they don't tell you
  • one day they'll get sick of it and just won't turn up
Impact on health and safety

• significant improvement in sharpness levels

Each bar is the average sharpness for that day

Same people, same equipment

5x sharper!
Impact on throughput

- impact of improving the slowest link

Max. cuts per minute

12  10  8  12

Team = 8 cuts / min

25% improvement in just one team member

12  10  10  12

Team = 10 cuts / min

25% improvement in team performance!
Impact on effective management and control

Rapid improvement & Rapid decay

Decay was much faster than we expected

Rapid improvement in sharpness levels & consistency when managed consistently

Rapid decay when management is interrupted!
Nationwide sharpness survey

Poor sharpness is endemic (globally, regardless of species & location)

There are always some very good sharpeners

The worst sharpeners use vastly more force than even the average, let alone the best
Sharpness is worth the effort!

It takes a coordinated investment of time and capital

---

### Production Information

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>average carcass weight</td>
<td>180 kg</td>
</tr>
<tr>
<td>yield of meat from carcass</td>
<td>70.6%</td>
</tr>
<tr>
<td>speed of processing line</td>
<td>3 ccs/min</td>
</tr>
<tr>
<td>length of shift</td>
<td>8 hrs</td>
</tr>
<tr>
<td>processing lines operating</td>
<td>1</td>
</tr>
<tr>
<td>shifts per day</td>
<td>2</td>
</tr>
<tr>
<td>production rate</td>
<td>2,880 ccs/day</td>
</tr>
<tr>
<td>production days per week</td>
<td>5</td>
</tr>
<tr>
<td>weight of meat produced</td>
<td>1,829,952 kg/week</td>
</tr>
<tr>
<td>average product value</td>
<td>2.25 per kg</td>
</tr>
<tr>
<td>value of production</td>
<td>$4,135,692 per week</td>
</tr>
</tbody>
</table>

---

### Quality Benefits

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>wgt of product saved from trim</td>
<td>0.05 kg/ccs</td>
</tr>
<tr>
<td>previous value (trim)</td>
<td>1.36 per kg</td>
</tr>
<tr>
<td>new value (loin)</td>
<td>5.5 per kg</td>
</tr>
<tr>
<td>added value from quality</td>
<td>$2,981 per week</td>
</tr>
<tr>
<td>season length</td>
<td>48 weeks/yr</td>
</tr>
<tr>
<td>yield and quality benefits</td>
<td>$639,381 per annum</td>
</tr>
</tbody>
</table>

### Health & Safety Benefits

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>knife related injury costs</td>
<td>$60,000 per annum</td>
</tr>
<tr>
<td>anticipated reduction**</td>
<td>50%</td>
</tr>
<tr>
<td>health &amp; safety benefits</td>
<td>$30,000 per annum</td>
</tr>
</tbody>
</table>

### Investment & Return

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>total benefits</td>
<td>$669,381 per annum</td>
</tr>
<tr>
<td>sharpness investment</td>
<td>$30,000</td>
</tr>
<tr>
<td>Payback</td>
<td>2 weeks</td>
</tr>
<tr>
<td>1 year Rol</td>
<td>2.031%</td>
</tr>
</tbody>
</table>

---

**based on indicative study in beef boning room that showed 1.3% yield improvement if all processing staff are able to maintain a consistently sharp knife.**

**based on research studies and years of customer experience showing at least 50% reduction in soft tissue injuries when using a sharp knife instead of a knife sharpened to the industry average.**

©2018 Anago Ltd

Ludicrous Payback!
Harder to ignore

Global awareness and visibility
• processing staff
• sharpening staff
• trainers
• suppliers
• managers
• owners

Objectively evaluate options
• it now exists!
• use it to choose what works
  - as an industry
  - as a company
The Sharpening Process

Grinding
- remove metal behind the cutting edge

Honing
- generate the sharp cutting edge

Polishing
- smooth and deburr the final edge

Steeling
- maintain the cutting edge

Measure
- enables closure of the QC loop
Sharpening Options (grinding & honing)

External 3\textsuperscript{rd} party sharpening service

- Knives are sent to and external provider for sharpening
- Pros
  - don’t need to capital equipment
  - operating, not capital expense
  - don’t need to have sharpening staff
  - can set quality control standards
  - specialists
  - easy to organize

- Cons
  - usually less frequent sharpening
  - little or no control over sharpening processes used
  - often less sharp than a skilled internal operator
Sharpening Options (grinding & honing)

Internal 3rd party sharpening service

- A 3rd party runs the internal sharpening process for you
- Pros
  - sharpening occurs on site
  - minimal or no capital outlay
  - staffing managed by the 3rd party
  - knives can be more economically sharpened at higher frequencies
  - specialized focus
  - can specify sharpness levels
- Cons
  - less control over system & staffing compared to fully internal
  - may cost more per knife than internal
Sharpening Options (grinding & honing)

Internal centralized sharpening

• You own and run the internal sharpening process for all knives
• Pros
  • you have total control over systems, staff and training
  • can easily set and manage control systems
  • can be cost efficient if run well
• Cons
  • can be a significant capital outlay
  • you have total responsibility
  • can be time consuming ensuring the sharpening system is running to standard
Sharpening Options (grinding & honing)

Internal individual sharpening

- Each individual is responsible for their own knives
- Pros
  - low capital outlay
  - responsibility lies with the individual
  - some individuals are much better at sharpening than dedicated sharpening staff
- Cons
  - large variability in sharpness levels
  - most people can’t sharpen that well
  - significant training effort required

‘Setter’ systems greatly improve sharpening skills and training rates
(score of 8 within 15 minutes)
Internal Centralized Sharpening

Manually operated sharpening machines
• usually 3 different machines required
  • grind, hone, polish
• lower capital cost
• usually more compact
• greater variability
• dependent on operator skill level
• less skill required to maintain

Automated / Robotic sharpening machines
• can perform all 3 steps in one machine
• larger machines with greater capital cost
• less variability
• lower operator skill required
• greater maintenance skill required
Sharpening Options (steeling)

Rod (or similar) steels
- operator controls the angle, pressure and speed of steeling
- Pro – experts are the best at steeling
- Con – great majority of people can’t

Spring loaded (or similar) steels
- device largely controls angle and pressure; operator controls speed
- Pro – quick to train people
- Con – not as good as an expert

Use of video during training
- helps operator to know exactly what they are doing
Knife Handling

General Handling

• Cut resistant gloves
• Keeping knives in sheathes is both safer and better for their edge

Knife Hand

• Cut resistant gloves can be used to prevent ‘run-through’ injuries
• Latex over-gloves have been used in harvest applications

Non-Knife Hand

• Chain mail gloves are safest
• Where not practical, use cut resistant gloves
Online Steering is CRITICAL

• Frequently underestimated

• A knife delivered to a team member can be dulled significantly in less than 5 minutes through poor steering technique

  • and that is then the sharpness for the rest of their shift

We cannot emphasize enough how critical effective management of online steering is to obtaining the best results from your sharpening program.
The Theory of Knife Sharpening

• What is cutting

• Impact of edge roughness

• Impact of edge angle

• What we seek to achieve from each part of the sharpening process

• Impact of blade length
How Cutting Works

• Separating, not splitting atoms

• Sharper angle = greater stress = less force for fracture

• Larger radius = more bonds working together to resist fracture
Edge Roughness

- Impact of edge roughness

**Figure 3: Edges prior to use**
- a) coarse;
- b) smooth;
- c) polished

**Figure 4: Edges after slicing**
- a) coarse;
- b) smooth;
- c) polished
### Smoother edges = less effort

<table>
<thead>
<tr>
<th>Edge Condition</th>
<th>Cut time (s)</th>
<th>Mean Grip Force (kgF)</th>
<th>Max Grip Force (kgF)</th>
<th>Mean Cutting Moment (Nm)</th>
<th>Max Cutting Moment (Nm)</th>
<th>Sharpness Force (kgF)</th>
<th>Sharpness Score</th>
<th>Roughness Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polished</td>
<td>5.31</td>
<td>3.03</td>
<td>5.07</td>
<td>1.94</td>
<td>4.66</td>
<td>1.86</td>
<td>8.4</td>
<td>0.29</td>
</tr>
<tr>
<td>Smooth</td>
<td>5.58</td>
<td>3.29</td>
<td>5.50</td>
<td>2.30</td>
<td>5.23</td>
<td>1.95</td>
<td>8.3</td>
<td>0.45</td>
</tr>
<tr>
<td>Coarse</td>
<td>7.11</td>
<td>3.84</td>
<td>6.81</td>
<td>2.71</td>
<td>6.38</td>
<td>2.40</td>
<td>7.7</td>
<td>0.60</td>
</tr>
</tbody>
</table>
Edge Angle

- Reduces cutting force at the edge
  - Alters stress concentration
- Affects edge life
  - Wider angles are stronger
- Affects ability of blade to reach the actual cutting surface
  - Narrow angles reach more easily
- Impact of product on cutting angle
  - Rigid product = narrower angle
    - e.g. chilled fat
  - Flexible product = wider angle
    - e.g. hot beef

Thickness & Flex impact ability of product to flex away from the cut surface

Have to push harder to reach the cut surface
Grinding Knives

• Goal is to simplify honing
  • Remove excess steel
  • Thin blade behind the edge
• Recommend 60-80 grit
  • Coarse enough
  • Makes honing with smoother stones easier
Honing (Stoning) Knives

• Goal is to generate a sharp edge
  • Hollow ground knives – only need to stone the edge (shoulder)
  • Flat ground knives – need to stone side and edge

• Technique
  • Maintain a constant angle
  • Remember that the tip is curved
  • Firm, gentle strokes
  • Finish with as smooth a stone as time allows

• Recommend 600 grit
  • and finish with 1000 polish to remove burr
Understanding the impact of technique

- Approx. 7.8 passes the paper test
- Approx. 8.4 shaves

Need to focus on the curved tip
Steeling Knives

• Goal is to straighten the tip
  **NOT** to remove metal

• Technique
  • Same angle as edge
  • Gently
  • Smooth steel

**REMEMBER**

We are merely maintaining the edge produced by honing

A lot of facilities do great work with sharpening; their next step is to improve online steeling
Impact of Blade Length

• Distance between cutting point and handle

• Lever action
  • Longer distance = greater effort to prevent twisting
  • Twice the distance = twice the force
Best Practices in Knife Sharpening and Handling

Peter Dowd
Founder & Principal Consultant
Anago Limited
peter.dowd@anagosharp.com