raft

Rebuilding lives
through science
and imagination

30TH ANNIVERSARY

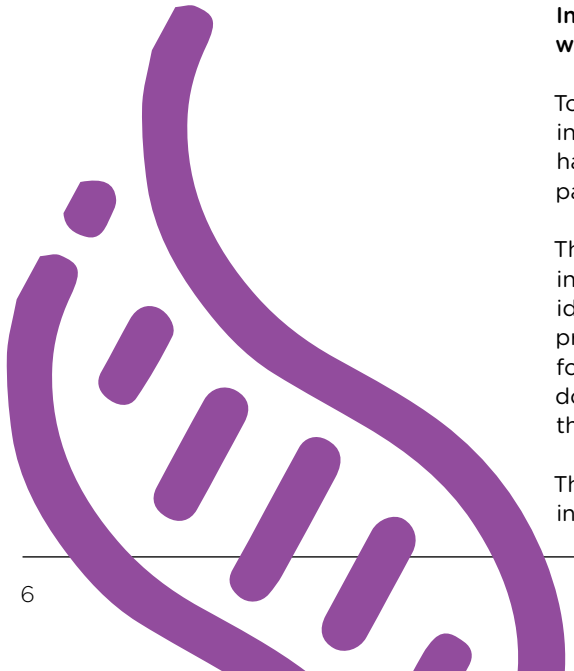
Welcome to RAFT
Rebuilding lives through science and imagination

raft
Restoration of Appearance and Function Trust

CONTENTS

30 years of RAFT
Rebuilding lives through science and imagination

Over 30 years, RAFT has transformed medical science. You may not be aware of it, but your life – or that of someone you know – will have been affected by our work.



More than 100 of RAFT's projects are used in hospitals and clinics to change the lives of patients. Throughout its history, surgeons, scientists and researchers have worked together at RAFT to tackle some of the biggest challenges in medical science. They have improved the way burns are treated, how plastic surgery is performed, how skin cancer is diagnosed, and how life-changing conditions like toxic shock are assessed.

In just 30 years, RAFT has changed the world.

Today, RAFT is one of the world's leading independent medical research charities. It has established global collaborations and partnerships that are helping it grow.

The charity matches inspiration with innovation – transforming the incredible ideas of surgeons and scientists into practical ways to improve lives. True to the founders of the charity, the work RAFT does is driven by the needs of patients and the demands of surgeons.

The impact of RAFT isn't just measured in incredible discoveries. It spreads much wider.

Since 1998, RAFT has supported scientists to gain PhDs, published over 330 papers, and seen its research cited more than 8,000 times. The organisation has won 63 national and international awards for its research work.

Some of the world's best plastic surgeons have spent time at RAFT, developing skills and experiences that have informed their careers. To date, 54 surgical research fellows have worked at RAFT, with every single one leaving their mark.

Transferring innovation from the bench to the bed is core to RAFT's identity. Everything it does is focused on improving the lives of patients. It's about helping them reconstruct the future after trauma.

> "To date, 54 surgical research fellows have spent time at RAFT, with every single one leaving their mark."
> Professor Roy Sanders

At RAFT, everyone and everything is informed and inspired by the science and the research. Fundamental to this is a core belief that everyone should understand what's happening under the same roof. That includes patrons, fundraisers and the generous donors who help to sustain the charity.

This book attempts to capture what RAFT has achieved and some of the lives that have been changed.

But the story is far from complete.

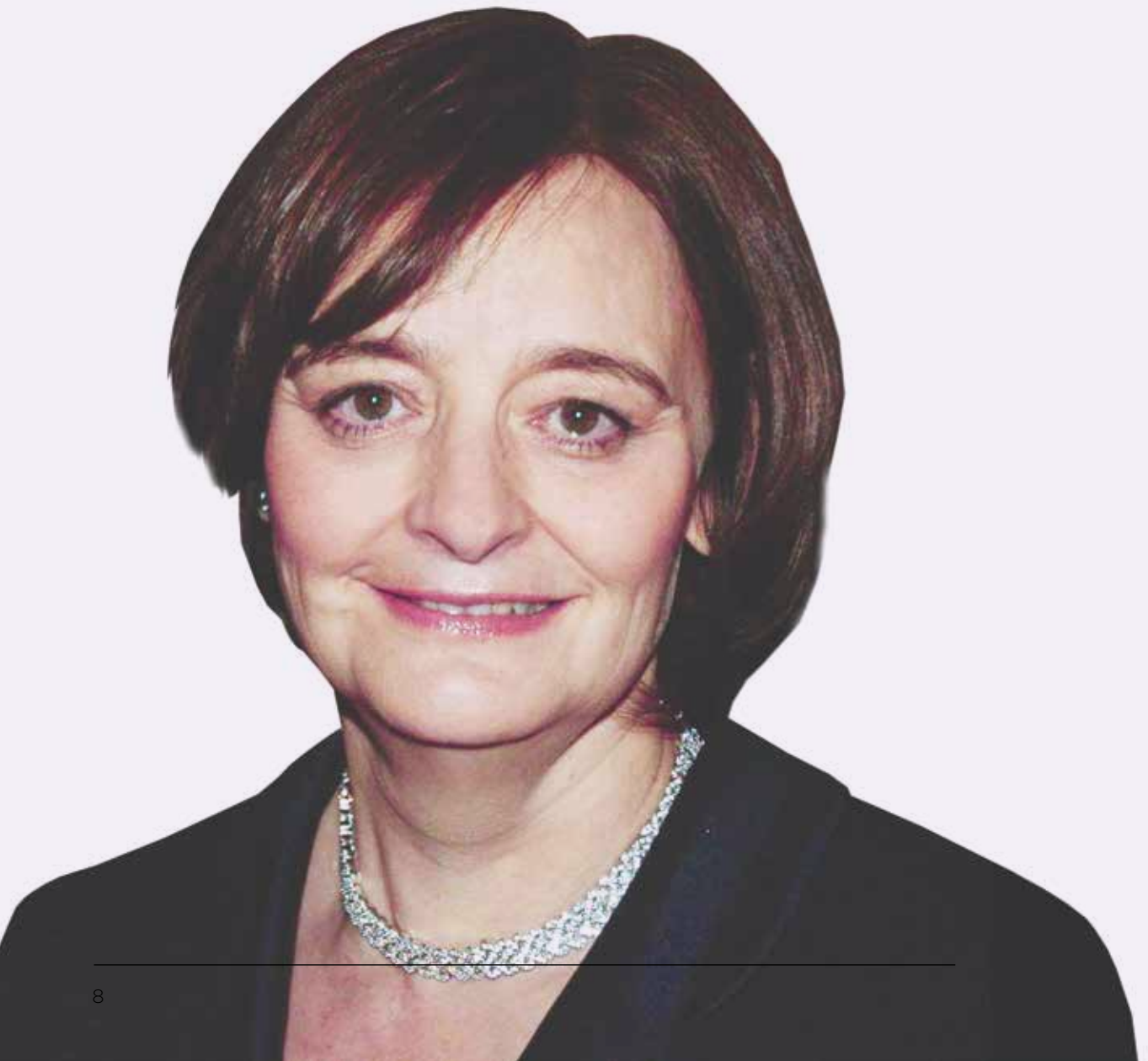
The work that RAFT is doing today will change the world tomorrow. Innovations like Smart Matrix®, Smart CaP and the incredible 3D-printed facial implants will change surgery. The breast reconstruction work will offer women recovering from the devastating impact of mastectomy the prospect of a better future. The bionic limb project is creating intuitive and responsive prosthetics that will change what's possible for those living with amputated or missing limbs.

—

Welcome to RAFT: where science and imagination combine to change lives.

WHAT RAFT MEANS TO ME

Cherie Blair CBE



Cherie Blair CBE has been a patron of RAFT since 2005. She was drawn to its work after her father, the actor and campaigner Tony Booth, suffered burns to a significant proportion of his body after an accident. She is closely involved in promoting the work of RAFT, helping to shape the charity for the future.

"In 1979, my father had an accident, and I used to come and visit him at Mount Vernon Hospital," explains Cherie Blair. "I have had a personal experience of the devastating effects of burns and skin grafts."

Describing the impact these visits had on her is painful, but they have clearly given her an understanding of the impact of the work that RAFT does. "When RAFT approached me, this [the impact of burns] was something I'd seen for myself, and it was then that I agreed to become a patron," she says.

Accompanying Cherie as she enjoys one of RAFT's famous laboratory tours is fascinating. She is keen to engage not only with the scientists but the science too, taking an interest in new developments like Smart Matrix® and the complex polymers that are being used to encourage the growth of new bone tissue.

"It's been very exciting to see how organically the work has been done in the materials," she says. She talks enthusiastically about RAFT's new projects, as inspired by the creativity and innovation of the researchers as by the life-changing potential of their discoveries.

During her time as a patron, RAFT has changed, embracing a more commercial focus. In challenging times for charitable funding, she is acutely aware of the need for organisations like RAFT to maximise the potential for their innovations. "As the strain on public finances goes on, it's really becoming imperative," she adds.

"What I like very much is the fact that it's now a freestanding organisation," she says, discussing RAFT's focus on self-funding through the commercialisation of its research.

For Cherie, the close relationship between RAFT and the NHS is one that's mutually beneficial, providing a potential blueprint for other charities. "If we are using the amazing skills of our scientists in partnership with the NHS, there's a lot of sense in commercialising it. We can use the money from that commercialisation for further advances."

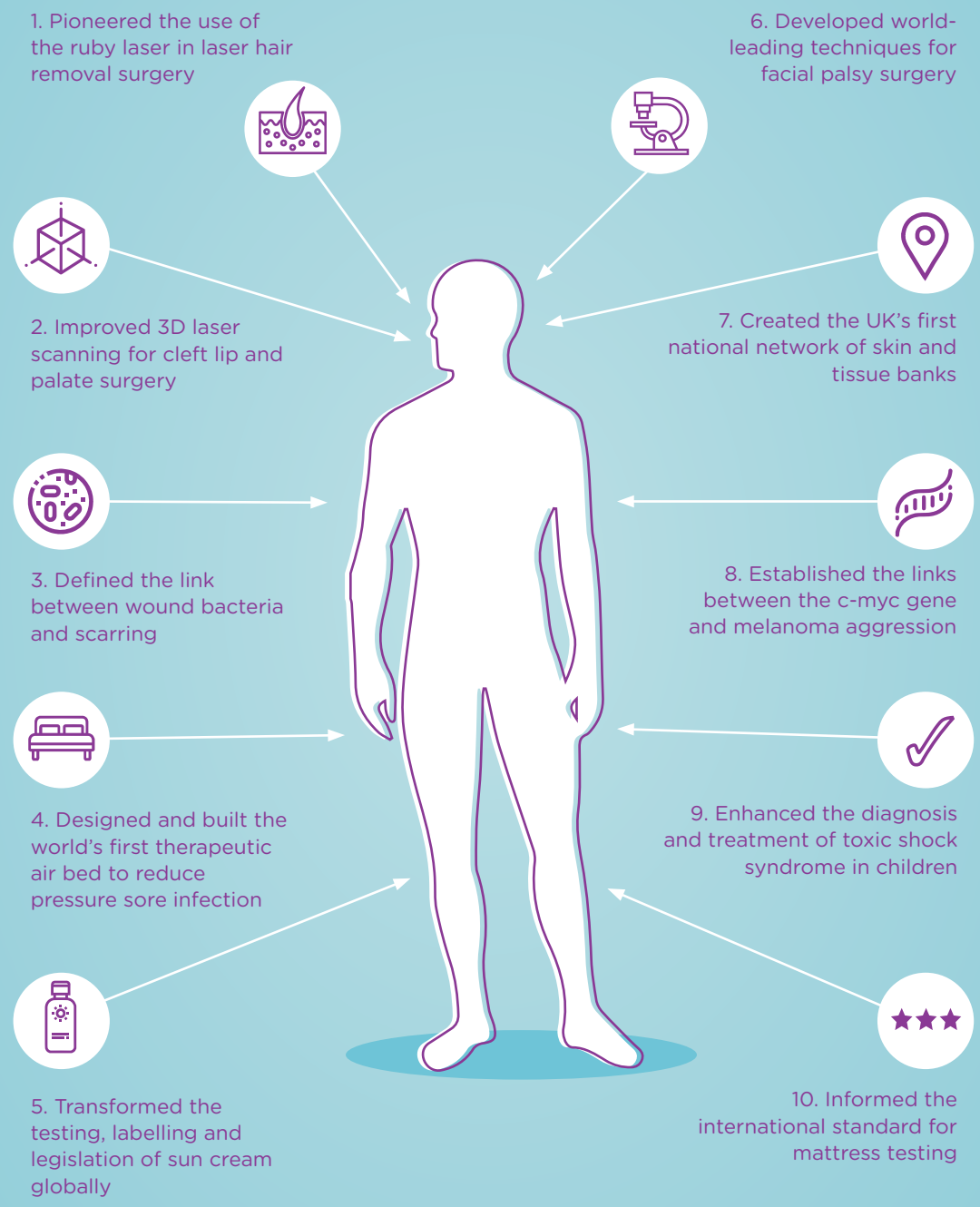
Throughout her professional and personal life, Cherie has encountered many people who have benefited from the work and innovations pioneered by RAFT. One of those, a survivor from the 7/7 bombings, clearly struck a chord, with Blair reflecting on how successful skin grafts are helping some of the people affected by major trauma to recover. They lead full lives even after devastating injury.

When asked how she'd describe the spirit of RAFT after more than a decade as a patron, Blair reflects. "Sometimes we think creative minds are all in the arts," she says. "But what we are seeing here is the creativity in science that leads to connections between the needs of the patients and a combination of science, engineering and surgery."

10 WAYS RAFT HAS CHANGED THE WORLD

Over 30 years, RAFT has saved lives, improved treatments, revolutionised medical practice and transformed laws. Every day across the world, the work of RAFT is making a difference.

It has achieved more than its founders could ever have imagined, with more than 100 projects in use across the world. But the work continues. Today the scientists at RAFT are developing new treatments and techniques that will change the world of tomorrow.



RAFT PIONEERS

Since it was founded in 1988, RAFT has been led by pioneers who have shared a vision for the power of medical science to change the world.

Sir Robin Chichester-Clark

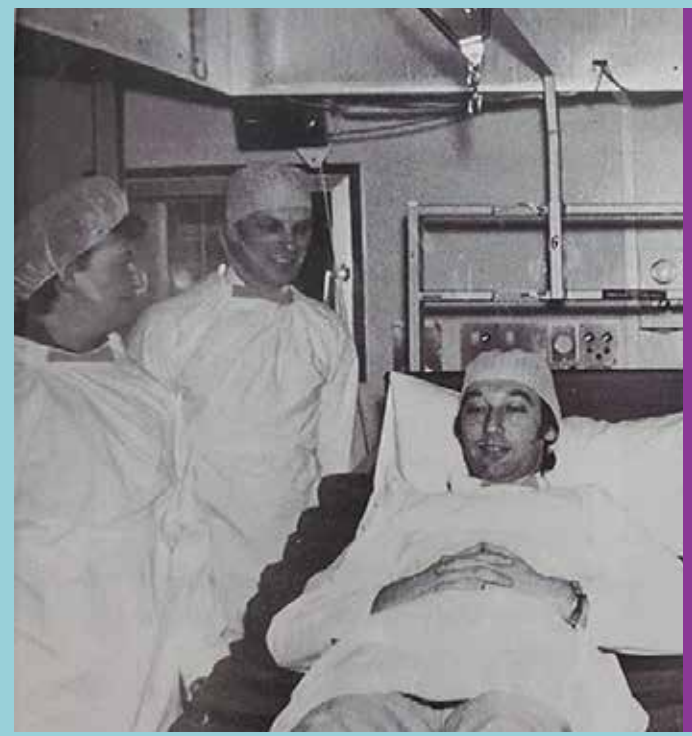
Sir Robin was RAFT's first chairman, and was instrumental in helping to establish the charity. His tireless enthusiasm and commitment to RAFT helped propel it to the forefront of medical research and practical medical innovation.

Sir Robin passed away in 2016, leaving a life-changing legacy in the form of his work for RAFT.

Professor Roy Sanders

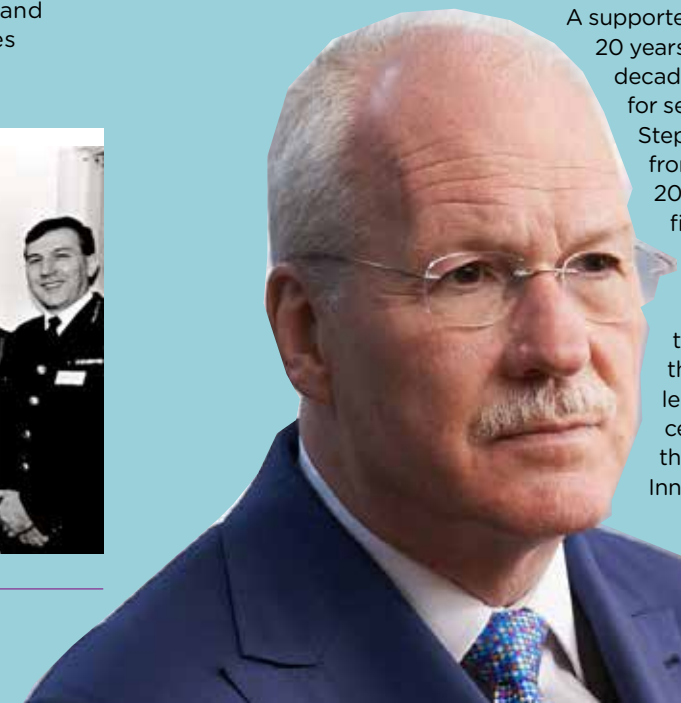
One of the UK's most respected plastic surgeons, Professor Roy Sanders was one of the four founders of RAFT, responsible for helping to name the charity. His vision, along with that of the other three founders, catapulted RAFT to the forefront of medical science.

His influence and insight led to some of our most memorable and impactful projects, including the investigation into skin cancer and sun cream that made headlines across the world.



Professor John Scales

A biomedical engineer by trade, Professor John Scales helped to establish RAFT as one of the world's leading centres for medical science. His work on pressure sores, and his revolutionary developments in therapeutic airbed technology, helped to create the field of biomechanical engineering and establish RAFT as a serious force for change.



Francis Gugen

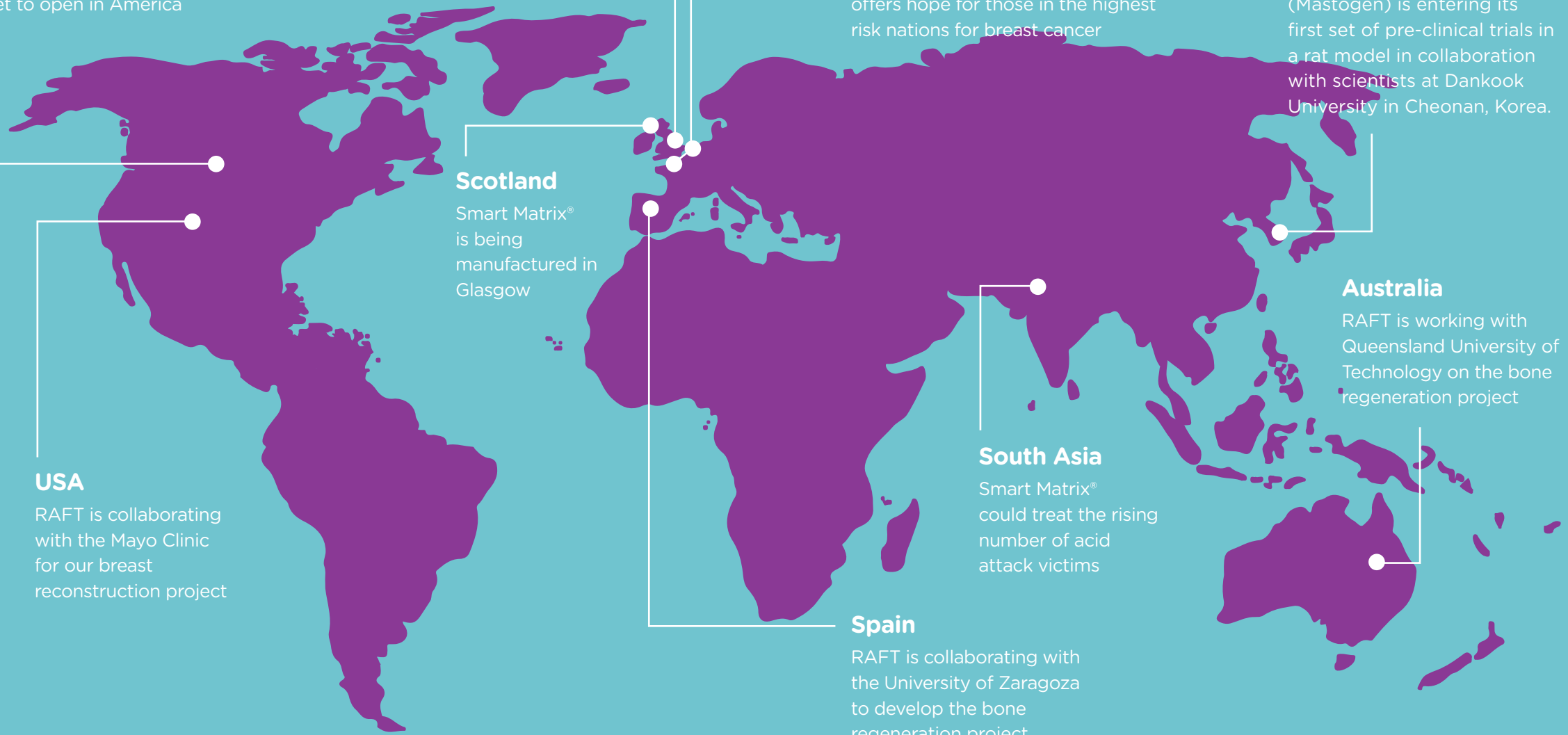
A supporter of RAFT for 20 years, a trustee for a decade and chairman for seven years. Stepping down from the role in 2017, Francis was a fierce champion of RAFT and the potential for science to change the world. His legacy has been celebrated with the Francis Gugen Innovation Prize.

Leonor Stjepic

Leonor was chief executive at RAFT for over 10 years. Under her guidance, the charity reached new heights, developing innovations like Smart Matrix® and Smart CaP that have enormous potential across the world. Leonor has helped to develop RAFT into an organisation that's more commercially focused, agile and targeted.

RAFT ACROSS THE WORLD

RAFT has spread across the world. The organisation's research partnerships and collaborations are developing new innovations that will change lives. Currently more than 100 RAFT projects are in clinical use across the globe.



USA
RAFT is expanding, with a new office set to open in America

UK
RAFT has research partnerships with UCL and University of Nottingham

Scotland
Smart Matrix® is being manufactured in Glasgow

USA
RAFT is collaborating with the Mayo Clinic for our breast reconstruction project

Belgium/Netherlands
The breast reconstruction project offers hope for those in the highest risk nations for breast cancer

South Korea
Our biological breast implant (Mastogen) is entering its first set of pre-clinical trials in a rat model in collaboration with scientists at Dankook University in Cheonan, Korea.

Australia
RAFT is working with Queensland University of Technology on the bone regeneration project

South Asia
Smart Matrix® could treat the rising number of acid attack victims

Spain
RAFT is collaborating with the University of Zaragoza to develop the bone regeneration project

WHAT RAFT MEANS TO ME

Duncan Bain

Duncan Bain is a pioneer of biomechanical engineering. Working alongside Professor John Scales, he was one of the first to help put RAFT on the research map. Here he shares his incredible story of discovery.

"One phone call from a lunatic and I found myself here...!" recalls Duncan Bain, as he begins to tell the incredible story of how a chance encounter resulted in him spending five years at RAFT. His work would change the way pressure sores were treated across the world.

"It just so happened that Professor John Scales had seen a device at Stoke Mandeville Hospital, called the giraffe o'scope, which I had designed."

"It was a device that allowed a spinal injured person on bed rest, who's spending the whole day lying on their back looking at the ceiling, to look around the room."

The giraffe-a-scope was an articulated mirror system that had quite complicated mathematics to allow two mirrors to move in such a way that you saw everything the right way up as you looked around the room. Sadly it never caught on, but the chance meeting was to form an enduring partnership between the two pioneers.

"Professor Scales had seen one of these contraptions somewhere and decided: 'I want to hire that guy for my pressure sore project.'" Says Duncan: "His policy had always been to hire engineers to solve medical problems because engineers create things to solve problems. That is not the way doctors' minds work."

The eccentric Professor Scales had a unique approach. Duncan continues the story: "I received a phone call one night and he [Professor Scales] said: 'Have you ever heard of pressure sores and pressure ulcers?' and I replied no. His next words were: 'Excellent! How would you like to run a pressure sore research programme?'"

Duncan was bemused and considered the idea ridiculous, until he met Dr Scales and learned a little more about the project and the impact it could have on patients. At the time, approximately 10% of all hospital patients would develop pressure ulcers, with damaging consequences to their health and costing the NHS many millions of pounds.

As first days go, finding a severed limb may put you off, but Duncan found it amusing. "I moved in to find a pickled leg in a cabinet in what was to be my office. An amputated leg in a jar! I never found out whose leg it was." He doesn't elaborate on what happened to the jar, but the old building – a prefabricated wartime structure, built to last five years but standing for almost 50 – is long gone.

Work began in an unconventional manner. "I set about making plaster casts of peoples' bottoms for a few years, which included some celebrities. One of our fundraisers was the wife of a theatrical agent, and she managed to arrange for celebs to come in and we would get plaster casts of their bottoms. After that, we used models from a local modelling agency quite a lot."

Sadly, he can't divulge their names. "We were sworn to secrecy because *The Sun* got hold of the story and we were there on page 3 of the newspaper."

The researchers may have found the juxtaposition of boffins and breasts amusing, but the unwanted attention drew censure from the hospital trust. "It was seen by the hospital authorities as trivialising the issues... we were told to be more discreet!"

The history of the project is well known, with Professor Scales and Duncan creating and using these plaster casts to develop a model test for mattresses, which is still used today. In time, they developed a pressure sore mattress that is now used across the world, improving the lives of thousands of patients.

It took a lot longer than expected. "I didn't succeed in solving the pressure sore problem in six months. I ended up staying a few years, doing a PhD on the biomechanical aspects of the aetiology of pressure ulcers."

Leaving RAFT in 1997, Duncan has gone on to have a successful career, undoubtedly shaped by his time with Professor Scales and the pioneering days of RAFT. His work can be seen as instrumental in the establishment of biomechanical engineering.

"Engineering is basically taking a problem and finding a solution to it," Duncan says. "Doctors don't solve medical problems or make medical advances – it's engineers or pharmacists or biologists, or basic scientists," he says. When they work together, they can change the world.

THE SPIRIT OF RAFT

Today, RAFT is one of the world's leading research institutes dedicated to developing transformative technologies. But to understand what RAFT is and what it does, it's important to start – as with all great stories – at the beginning.

"If RAFT didn't exist, we would have to invent it."

Dr Norbert Kang

The Restoration of Appearance and Function Trust was founded in 1988 by four plastic surgeons: Roy Sanders, Brian Morgan, Douglas Harrison and Paul Smith. The charity was formed around the shared belief that wound-healing treatments could be improved, with the name shortening quickly to the familiar acronym RAFT.

RAFT was built on the power of inspiration and innovation – transforming the incredible ideas of surgeons and professionals into procedures and technologies.

The founders recognised that ideas can change lives, and developed a culture that encourages surgeons, scientists and researchers to develop practical solutions to the problems they face.

The urgent need to transfer innovation from the bench to the bed has always been a fundamental part of RAFT's identity and success. It permeates everything that the charity does. All work has to have an impact as soon as possible, which is why research is focused on solving problems within a two- to five-year period.

Reflecting on the impact of the charity, Professor Roy Sanders was amazed at what he had achieved. "RAFT became known internationally as one of the greatest centres of research relating to plastic surgery."

RAFT in the future

In just 30 years, RAFT has surpassed the expectations of its founders. While the scope of the work RAFT does has changed since 1988, the unique relationship it has with the plastic surgery community remains.

RAFT's researchers can call upon the expertise and insight of some of the world's leading reconstructive surgeons. It helps them to develop solutions for surgeons.

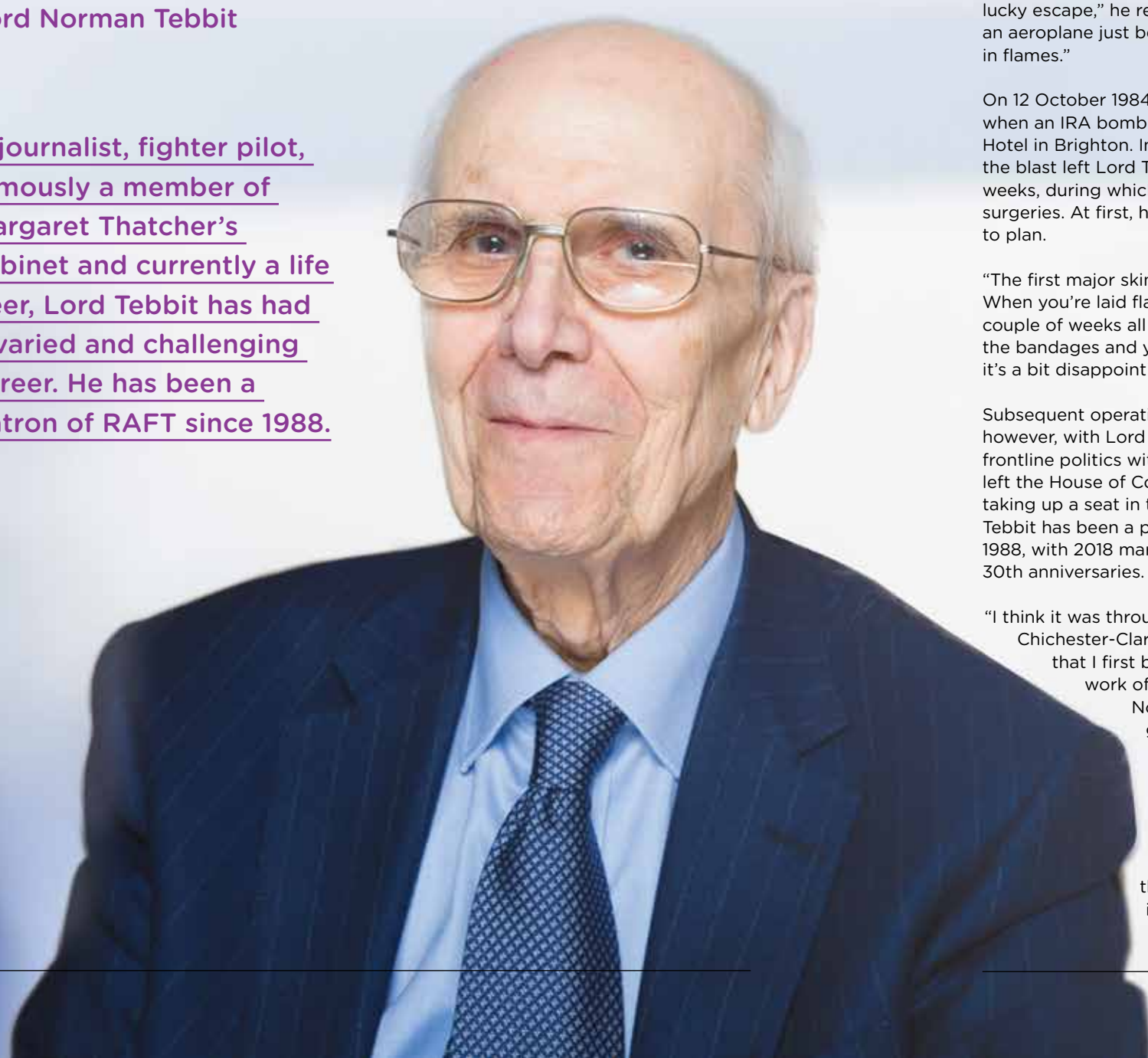
Every month, donors, stakeholders and members of the public are welcomed into the building to learn a little more about what RAFT's scientists are working on today. These tours provide a short but intense introduction to the work RAFT does. It is a powerful way to communicate the life-changing science being developed.

The scientists, researchers and surgeons at RAFT are able to develop their own approaches to problem-solving. They own their projects, working closely with a hand-picked group of collaborators to accelerate the development of medical innovations today that will change the world tomorrow.

WHAT RAFT MEANS TO ME

Lord Norman Tebbit

A journalist, fighter pilot, famously a member of Margaret Thatcher's cabinet and currently a life peer, Lord Tebbit has had a varied and challenging career. He has been a patron of RAFT since 1988.



Lord Tebbit spends some time reflecting on a career that has seen him work as a journalist, a pilot and a cabinet member for Mrs Thatcher. During his time in the RAF, and as a commercial pilot, he avoided accident or injury. "In my early flying days I had the odd lucky escape," he recalls. "I once got out of an aeroplane just before it finally went up in flames."

On 12 October 1984, everything changed when an IRA bomb exploded at the Grand Hotel in Brighton. Injuries sustained during the blast left Lord Tebbit hospitalised for 10 weeks, during which he underwent multiple surgeries. At first, however, things didn't go to plan.

"The first major skin graft I had didn't work. When you're laid flat on your back for a couple of weeks all tied up, and they undo the bandages and you find it's not worked, it's a bit disappointing," he says.

Subsequent operations were successful, however, with Lord Tebbit returning to frontline politics within weeks. He finally left the House of Commons in 1992, before taking up a seat in the House of Lords. Lord Tebbit has been a patron of RAFT since 1988, with 2018 marking both his, and our, 30th anniversaries.

"I think it was through Sir Robert (Robin) Chichester-Clark (RAFT's first chair) that I first became aware of the work of RAFT," explains Lord Norman Tebbit. "He was a great man for involving people," he says, smiling.

When discussing why RAFT is important, he is positive about the impact the charity is having on patients. "Some of the work that's been done recently, particularly on improving the techniques of skin grafting, has been quite outstanding," he says.

"It's reducing the amount of pain and stress, reducing the likelihood of infection, and increasing the chance of a good graft straightaway," he adds, channelling his personal experience.

RAFT isn't the only medical charity for which Lord Tebbit is a patron. When asked why he has committed time and support to RAFT for such a long time – for over 30 years, in fact – he says he's inspired by the approach of its scientists.

"Their thinking, as they say these days, is outside the box. I think that's what has always attracted me to the work and people in the most advanced and experimental areas of medical science," he says.

"What I love about all of this is the questioning. They're open to new ideas wherever they come from. That's what I really like," he continues.

The work of RAFT, he believes, isn't just about ensuring that patients' lives are saved. It's also about "enlarging their lives, bringing them further back into life."

During his time with RAFT, Lord Tebbit has met many of the scientists and practitioners who have made their mark on the charity. How would he describe the unique spirit of the organisation? "The guys concerned all seem to be highly individualistic and they have the capacity to take ideas from outside the usual scope," he says.

One question remains. As someone who has himself experienced major trauma, including extensive reconstructive surgery, just how did Lord Tebbit make such a rapid recovery? "I wanted to get out – it was coming up to Christmas!"

10 WAYS RAFT HAS CHANGED THE WAY WE THINK

For 30 years, scientists at RAFT have developed novel and innovative approaches to problem-solving, using science and imagination to change lives.

1. Built the world's first floating bed, supporting patients in the air to treat those with burns and pressure sores

2. Used plaster casts of celebrity bottoms to develop the world's first mattress-testing dummy

3. Conducted the world's first trials of insulin as an anti-scarring agent

4. Discovered a new blood vessel in the human body

5. Investigated the use of green tea, honey and sugar for wound healing

6. Scientifically proved that caffeine and microsurgery don't mix

7. World's first use of ruby lasers to test for UV damage in skin, transforming the way sun cream is tested

8. Identified the optimum way to apply sun cream to maximise protection

9. Established the potential for the c-Myc gene as a predictor for cancer

10. Created new methods for attaching leeches to surgical wounds

> A PLASTIC SURGEON'S VIEW OF RAFT

Bruce Philp

Now one of the UK's leading plastic surgeons, Bruce Philp remembers his time at RAFT fondly. "I was a surgical research fellow here from 1993 to 1996 and I was studying for a PhD. I've nearly finished it," he says with a smile.

In an academic career that included periods studying at both Oxford and Cambridge universities, how did Bruce end up at RAFT? "I did a two-week attachment to plastic surgery as a sort of special study module and I thought I wanted to be a burns surgeon."

The route into plastic surgery is a tough one, however. "It was mega-competitive then, and it still is." He adds: "I didn't have much career advice. It was sort of 'wing it and do it yourself' in those days. However, someone sensible said: 'Do some research and try and do it somewhere that's good.'"

This advice led Bruce to apply for a research fellowship looking at cultured skin for burns. He was up against a friend – Simon Myers, now a professor of plastic surgery at Barts in London. "They interviewed us both. I don't think there was anyone else. He got the proper job and they made another job for me. So I must have done something to impress them!"

During his time at RAFT, Bruce was part of the team that developed the world's first laser hair removal treatment. He and a colleague found unconventional ways to test the lasers. "We tattooed some grids on our arms and lasered ourselves," he says with a laugh.

Self-testing being an ethical – although not always wise – approach, Bruce helped to establish the potential for laser surgery. He gave the first presentation ever on laser hair removal at the British Association of Plastic Surgery at their winter meeting. It was the start of the rapid adoption of this incredible new technology. "It's now a multibillion dollar industry worldwide. I'm now a laser surgeon myself, too," he adds. Once his time as a surgical research fellow came to an end, Bruce built a successful career as a plastic surgeon and currently works at St Andrews Centre for Burns and Plastic surgery in Chelmsford, Essex. It's the biggest burns unit in England, and on published outcomes the best burns unit in the world.

Bruce describes RAFT as an incredible place to work. "It made me understand how science actually works as opposed to theoretically works. It made me appreciate how difficult it is to get good results; to choose a proper experiment in which you only alter one variable. And it made me appreciate the scientific method, which is to have an idea, test it by experiment and analyse the results. Then publish it, present it and let other people run with it."

"I was much more rounded, much more mature. I understood science better. I understood medicine better. I understood surgery better."

The experience fundamentally changed him. "As a doctor, as a surgeon and as a scientist, I came away completely different to when I came in," he says. "I was much more rounded, much more mature. I understood science better. I understood medicine better. I understood surgery better."

He affectionately describes RAFT as a training ground for surgeons. "I think all surgical research fellows have got consultant plastic surgery jobs," he says. In 2018, Bruce hopes to finally complete his PhD, rounding off neatly his relationship with RAFT.

When asked what RAFT means to Bruce, he leans back and contemplates the question. "It made my career," he replies.

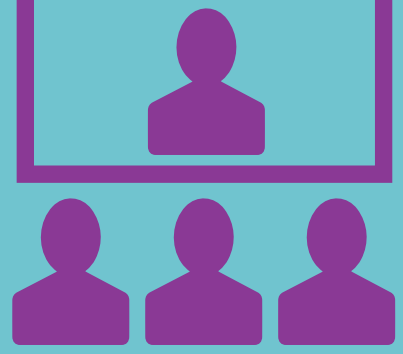
RESEARCH EXCELLENCE

Everything RAFT does is backed up with rigorous scientific research. The organisation is now one of the world's leading independent medical research charities, with an impressive record of academic achievement.

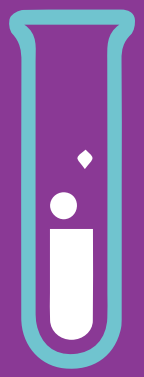
RAFT measures the impact of everything it does

RAFT has published over 330 papers

RAFT doesn't just produce research, it trains researchers too



RAFT has trained 54 research fellows



Research produced at RAFT has been cited over 8,000 times

RAFT has won 62 awards for its research

RAFT's scientists speak at conferences around the world

RAFT collaborates on research projects with partners across the world

WHAT RAFT MEANS TO ME

Ferrial Syed

After a childhood injury left Ferrial Syed with burns covering 70% of her body, revolutionary treatment using skin transplanted from deceased donors by Professor Roy Sanders changed her life. These unfortunate circumstances have seen the lives of RAFT and Ferrial interwined.

When Ferrial Syed was just two, playing with matches turned to tragedy when she set fire to her dress. She was rushed to Ealing Hospital and the tragic accident was to change her life – and make headlines across the world.

"Normally you would take a skin graft, but because there wasn't really much of an area to graft, they said it didn't look good," says Ferrial.

Typically, a patient with severe burns would receive a skin graft, but the injuries to Ferrial's small body were so extensive – covering 70% of her skin – this wasn't an option. It was at this point that RAFT became involved.

Ferrial continues: "At the time RAFT were doing research with Prof Roy Sanders, the surgeon, and he was working on a treatment which used skin from a dead donor to cover the burns in live patients."

Too young to remember the incident, or its aftermath, Ferrial has pieced together the story from the reminiscences of her family, and from the hundreds of newspaper articles.

"My mum used to say she's never seen so many doctors in one room." Once completed, the doctors waited anxiously to see if the procedure had worked. "Then they took the donor skin off and my skin had healed underneath. They said that I was going to make a full recovery."

During the procedure, surgeons used portions of Ferrial's skin and that of compatible donors to cover her extensive burns. At the time, Ferrial was the youngest patient ever to undergo the procedure, which caught the attention of the global media. Reflecting on the coverage today, some of the headlines are shocking, but it helped to establish RAFT as one of the world's leading medical research organisations.

The initial procedure was a success, but it's been a long road to recovery. "I can't begin to count how many surgeries I've had," she says.

Today, it's hard to see the signs of her injuries, but this hasn't always been the case. "When I was a child I had a lot of people staring or looking and my parents used to say: 'Well they're just curious, they just want to know.'"

For Ferrial, her work as a patron isn't about lending her name to something, it's an active commitment to engage, sharing the message of RAFT by speaking at the House of Commons or at laboratory tours. It often involves sharing details of her amazing story, which some could find painful.

"I think it's about having that confidence to explain, well, actually this is what happened to me, and this is what's happening at RAFT. The research that is happening, this is what we can do to help other patients," she says.

In one touching story, Ferrial remembers meeting Professor Sanders at an event. She was surprised to learn that Professor Sanders had a picture of Ferrial and her mother in his study. Reflecting on the meaning of this, she concludes that the procedure changed both of their lives.

The time spent in hospital has had a profound impact on Ferrial, but not necessarily in the way you'd expect. "I work in clinical trials now," she says. "It's funny. People say to me: 'You have spent your whole life in a hospital and you want to work in a hospital still?' And I say yes, actually I do."

The impact of research on Ferrial's life has given her a lifelong commitment to research, understanding how the projects on the bench can be transferred to the bed. The lives of Ferrial and RAFT seem intertwined, with her choosing a career in research now, and making her own contribution to medical science.

How would she describe the RAFT spirit? "They see and understand things from the patient's side. I think it helps them when they do research like this to see what patients really need as well," she answers, with an infectious smile.

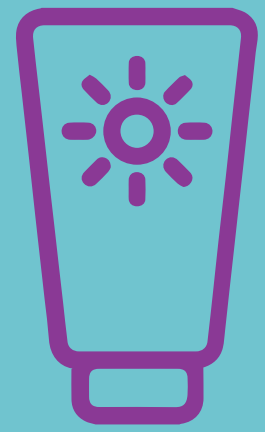
"I think with RAFT, they really all have that. Everyone who works here and everyone who does the work – they all really believe in it and they really want to help people, which makes such a difference."

RAFT IN THE MEDIA

Since 1988, RAFT's focus on science and research that can change lives has captured the attention of the media. The projects developed at RAFT have made headlines, not just in the UK but around the world. Here are five stories that have helped to establish RAFT as one of the world's leading medical research charities.

19 Feb 1996
Daily Mirror
"Hair-razing idea!"
The work on laser hair removal has helped millions of patients across the world. The *Daily Mirror* treated the news with typical restraint.

1 Nov 1989
The Times
"Life of burns victim saved by pioneering skin graft operation"
In 1989, RAFT co-founder Roy Sanders made news across the world by performing life-changing plastic surgery on two-year-old Ferrial Sayed. His life, hers, and RAFT's would never be the same again.



18 Jul 2006
The Daily Mail
"Don't rub in suncream"
In 2006, RAFT's research on suncreams was a front page story everywhere. It helped to change legislation, improving skin protection – and suncreams – across the world.

2 Jun 1998
The Sun
"What an ear-o: Surgeon builds an ear for lad born with one" When plastic surgeon David Gault created a new ear for 14-year-old George Sweeting, it became a story that captured the attention of journalists and readers.

30 Sep 2017
Medical Life Sciences
"Revolutionary skin treatment offers hope to acid attack victims, burns patients"
The focus for some of our most influential journal articles, the mainstream media is beginning to grasp the life-changing potential of Smart Matrix®.

WHAT RAFT MEANS TO ME

Richard Richards

While recovering from burns sustained in a fire, Richard was introduced to the work of RAFT, becoming a patron in 2012. Here he shares his incredible story of recovery.

A three-story terraced house in London was ablaze, with temperatures inside reaching an incredible 700˚C. The first firefighters on the scene believed everyone had safely left the building, but they couldn't be sure, so 26 year-old firefighter Richard Richards and three colleagues bravely battled their way into the inferno to find out.

Everyone in the building had made their way out, but Richard found his escape route blocked by falling debris. He managed to break out, being dragged from the burning building while unconscious. While he was still alive, the fire had taken its toll, leaving Richard with second- and third-degree burns covering almost 20% of his entire body.

"It was a typical, bog-standard job," says Richard, picking up the story. All four firefighters managed to exit the building, but all suffered burns, with Richard the worst affected. Regaining consciousness, Richard was thankful. "I knew I had survived," he said, but aware of his injuries he started to think about what life would be like after the fire.

As a firefighter, you learn to trust in other people – your life could depend on it. Richard put his faith in the surgeons who looked after him, who succeeded in grafting skin from his body to cover his scars.

"When I was in hospital I thought: 'You guys are the professionals and the experts at what you do, so I'm just going to trust your ability and your training to kind of see me through this."

Today, it's hard to spot the signs of burns when talking to Richard, but the scars are there. "As a result of all the skin grafting, because they take stuff from your donor site, I ended up with 40% of my body being scarred."

It was while recovering from his injuries that Richard became aware of the work of RAFT. "Our commissioner at the time was very passionate about the work that RAFT was doing as a charity." It inspired Richard to become a patron.

Leaving hospital, Richard had to deal with the emotional and physical scars of his ordeal, both providing a constant reminder of what he had been through. "The hardest thing for me was getting used to how I looked. And then also public perception, which initially I struggled with," he says. "It took me a long time to adjust to all of that."

Over time, Richard has come to accept the attention. "You realise that it's only a kind of fascination, and it's just human nature - being inquisitive." He now uses his story of bravery and recovery to help others – within the fire service and outside of it – learn more about dealing with trauma, and help them on their road to recovery. He also uses his experience to promote the work of RAFT.

"The work and research that RAFT does is still very highly regarded by the brigade," says Richard proudly. "You guys are pioneering new treatments that can help future firefighters, not just in London but across the country."

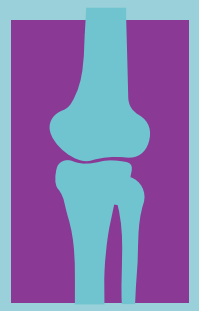
Discussing the impact of Smart Matrix® and its ability to help wounds heal without scarring, he channels his own experience. "You can't put a price on it. You can't really measure it in terms of what it would do to their confidence."

"They are pioneering something that is going to help reduce additional suffering," he says, considering the work that RAFT researchers have done. "It doesn't take massive facilities and labs to put together and pioneer life-changing interventions that will have a profound impact on people's lives."

THE FUTURE FOR RAFT

Scientists and researchers at RAFT are working on the innovations that will transform tomorrow. Collaborating with some of the world's leading institutions, the future promises to be incredible.

The unique wound healing scaffold, Smart Matrix® developed by RAFT, could change the way burns are treated across the world.



Smart CaP encourages the human body to regenerate its own bone tissue, revolutionising the bone graft industry.

New 3D-printable compounds being created at RAFT will help those who have experienced facial trauma to smile again.

RAFT is helping patients recover from breast cancer. Two new projects will help women rebuild their lives after mastectomy.

Intuitive bionics being created by RAFT could transform what's possible in human prosthetics.

> DIRECTOR OF RESEARCH

Dr Elena Garcia

Elena is an honours PhD scientist with over 14 years' research experience in biomaterial development, tissue engineering, stem cell biology, biochemistry and analytical chemistry. She has been at RAFT since 2011.

What inspired you to work at RAFT?
When I began to investigate RAFT, what captured my attention was the duality between academic research and the more commercially-focused translational research that impacts patients.

Working in academia, I could sometimes feel out of touch with people, and when I saw the ad about this job at RAFT I realised that I would be in touch with donors and patients, and I would be looking for real solutions to problems. These are the reasons why I am here.

What have you achieved at RAFT?
When I started at RAFT, I initially focused on skin wound healing, working on the Smart Matrix® project. I was involved in the formulation of the current Smart Matrix® product, and the successful work to obtain a patent for it.

My PhD was in bone regeneration, and so within six months I started work on adapting the Smart Matrix® technology for this purpose. This is now one of our core programmes. As the director of research and group leader of the Regenerative Biomaterials Research Group, I am involved to some degree in all of the projects we're currently working on at RAFT.

What do you enjoy about working at RAFT?
RAFT is very dynamic. There's always something going on. I think it's completely impossible to get bored at RAFT.

As scientists, we often just live within our shells. We write statements, complete our data analysis, go to conferences and that's pretty much all we do. At RAFT, you become involved with many other things like fundraising, talking to patients' groups, and explaining our research to visitors during our regular open days.

I also enjoy the opportunity to talk about science at conferences across the world. Of course, I still do a bit of experimental work myself when I can, and spend some time in the lab every now and then.

Have does RAFT today compare to 2011?
When I started at RAFT it was one of those places that had the potential to become great, but somehow had chosen to remain small and local. Some of the projects were very random and there wasn't a common strategy or theme running through the research. Since then, a lot has changed.

A lot of the research that we now do focuses on biomaterials that can regenerate tissue, in some cases using stem cells. We're looking ahead and incorporating new technologies like 3D printing. Our focus on biomaterials is helping us to gain significant recognition and prominence.

While our research strategy may have changed, the focus of our work at RAFT – as it always has been – is on improving treatments for patients and helping them rebuild their lives after trauma.

What excited you about the work you are doing at RAFT?
The projects we are working on at RAFT today should deliver results in the next 5-10 years. We will soon see patients being able to benefit from the work that we are doing, and that's fantastic.

I'm very proud that with all of our current projects there is a clear product or application that will benefit patients. The science underpinning it is genuinely excellent.

Has working with external partners benefited RAFT?
Without question. We have established partnerships with great institutions like University College London (UCL) and the Mayo Clinic and will continue, if possible, to grow these collaborations.

Personally, I believe that each project should be done in collaboration with other organisations. My vision is for us to continue what we're doing, and to establish new and innovative projects with other amazing world-class institutions.

Dr Elena Garcia is director of research and is responsible for leading the scientific focus for RAFT

SMART MATRIX

A WORLD WITHOUT SCARS

Dr Stuart Brown and Dr Vaibhav Sharma explain why Smart Matrix can help the body heal itself without skin grafts, potentially transforming wound healing across the world.

RAFT research scientists: Dr Vaibhav Sharma, Dr Stuart Brown, Dr Elena Garcia
Present collaborators: Smart Matrix Ltd

Millions of people every year suffer the horror of full thickness burns – where the injury breaks through the epidermis, the outer layer of the skin, and its underlying structure, the dermis.

Such wounds can lead to infection and often leave deep scars. They're treated with skin grafts – an established technique with drawbacks of its own.

But now there's an alternative. Smart Matrix® - the culmination of 15 years of research and development by RAFT – is poised to become one of the most important developments in the charity's 30-year history. "It could transform the way burns are treated around the world," says RAFT researcher Dr Stuart Brown.

Smart Matrix® uses naturally occurring proteins to help the body heal and regrow skin. It's not just burns victims who could benefit. Smart Matrix® could be used on other full-thickness wounds caused by the removal of non-malignant tumours or traumas such as abrasions, lacerations and punctures.

It also has the potential to treat diabetic wounds and help elderly patients who have problems with the healing of their wounds due to poor circulation. It may be at the cutting edge of medical research but Smart Matrix® can trace its genesis back to one of RAFT's founding principles: restoring function after injury.

The concept is deceptively simple. Smart Matrix® is a 'scaffold' – a soft, malleable material that fits within the shape of the wound – and replaces the material lost in the injury. The body then uses the platform to create new blood vessels and skin cells. This natural form of recovery also ensures the best aesthetic results, creating new skin that contours to the unique shape of the body.

To understand why this is so revolutionary, consider a typical wound. Here, blood rushes in to fill the gap. A protein in the blood called fibrinogen is cut up into smaller pieces by blood enzymes at the wound site. The pieces, called fibrin, are linked together to make a solid blood clot.

Over time, the densely packed fibrin breaks down as cells eat away at it. This release of breakdown products encourages more cells to the site to proliferate and to ultimately heal the wound. When too much damage is done for the body to handle, you can observe the kind of scarring typically seen on those who have experienced severe burns.

As well as potential entry points for infection, these burns often leave deep scarring when they heal. To help restore appearance, burns require revision surgery to reduce scarring and skin grafts to help the healing process. They use portions of skin from the patient's body, or in some cases a donor. But although it's over a century since the first skin graft was carried out, and the procedure is now accepted medical practice, it's not without problems.

Smart Matrix© improves aesthetics and function. A typical skin graft will transplant skin from other areas, where it has different aesthetic and physical properties of elasticity, malleability and mobility. Smart Matrix® lets the body regrow its own skin in a way that isn't possible with a typical skin graft.

Building Smart Matrix®

Spread your fingers wide enough and you can hold Smart Matrix® in the palm of your hand. The 10cm-squared sheet of transparent protein weighs just a few grams. It's flexible and light, but strong enough to withstand surgical handling. This intricate, complex piece of layered protein is handled with care in the laboratory.

Smart Matrix® uses the natural protein fibrin to wage war on burns and scars. The team have taken that protein and given it a slightly different structure, spreading it out into a sheet that you can cut to the right size and put in a wound.

The pores within the fibrin scaffold allow the rapid movement of cells into the matrix. As the fibrin breaks down, it releases a chemical signal that attracts both blood vessels and immune cells to the wound, accelerating recovery.

Its ingenious composition also helps avoid the moral and religious objections that arise from using animal-derived structural proteins like collagen.

Over time, the Smart Matrix® scaffold completely disappears, leaving the patient with nothing but clear skin, where in the past there would have been a wound. Moreover, there are no concerns about the body having an adverse reaction. "It's simply human protein," says Stuart.

The healing potential of Smart Matrix® isn't limited to burns victims. It can be used as a direct substitute for the skin used in grafting surgery. Patients with skin cancer often undergo the removal of significant portions of skin and multiple graft procedures, which can be both painful and time-consuming.

There is also huge potential for treating diabetic wounds and long-term wounds in elderly patients caused by problems with blood supply. Stuart believes Smart Matrix® has the potential to dramatically reduce the recovery time and improve outcomes for these patients.

Researchers and surgeons are only beginning to explore the potential for Smart Matrix®. The current scaffold can only cover a modest area of the body, but its material properties mean that scaffolds could be developed or combined to cover almost any size of wound or injury.

The only limitation is the body's ability to generate cells to cover the area, something scientists are now turning their attention to.

SMART MATRIX

MASTERING THE MATRIX

It's surgeons, not scientists, who will define how Smart Matrix will be used.

Smart Matrix® is the culmination of over 15 years' research and insight. It's a huge commitment for a small organisation like RAFT, but the project remains true to the values of the charity. "It's about restoring appearance and helping patients to enjoy the future after injury," Stuart says.

The project draws inspiration from the scientists and researchers who have shared the same building and have created innovations that continue to transform care.

Stuart believes that having a small, highly focused team working on Smart Matrix® is a strength, describing the approach as maximising the charity's 'bang for its buck'.

Could a project developed by the small team at RAFT really transform the way burns are treated across the world? "Absolutely!" he replies.

In fact, Smart Matrix® is already proving a success. The first clinical trials were conducted in 2014 with favourable results, and the team plans further trials in 2018. In a healthcare environment in which funds can be scarce, and managing wounds is expensive, surgery with Smart Matrix® will be quicker, simpler and cheaper.

It's surgeons, not scientists, who will define how Smart Matrix® will be used.

RAFT's relationships with surgeons has helped to develop a product that can be used 'off the shelf'. This two-way relationship is practical, pragmatic and ongoing.

Once Smart Matrix® is in the hands of surgeons – and on the bodies of patients – there will be changes. "We have the ability to adjust the properties of the scaffold – adding more strength to the material. It's all about creating a functional solution that solves surgical problems," says Stuart.

The science behind Smart Matrix® is already being utilised in other projects, including Smart CaP, a project that's using the fibrin-based approach of Smart Matrix® to encourage the body to grow new bone.

The development of Smart Matrix® has taken 15 years, exactly half of RAFT's entire lifespan. It's a monumental undertaking for a small charity, demonstrating a commitment to the potential of the product and the principles of the charity.

"When you heal a wound with Smart Matrix®, the results are for life," says Stuart. "We hope treatment with Smart Matrix® will let you forget you ever had that injury, whatever the size and location."

Dr Stuart Brown
Dr Vaibhav Sharma
Dr Elena Garcia

Looking to the future

"The easiest way to help patients is to make sure the product reaches them and that they can use it," says Stuart, when asked what the future holds for Smart Matrix®.

Since 2008, RAFT has become more commercially focused and embraced the potential of its innovations. To help maximise the potential impact of Smart Matrix®, RAFT created an independent spin-out company dedicated to commercialising the innovation – Smart Matrix Limited.

The formation of Smart Matrix Limited in 2011 is helping to bring the technology to the attention of plastic surgeons and healthcare systems around the world. Building external relationships and attracting outside investment is the best way to exploit Smart Matrix® to its fullest potential.

This enterprise isn't about personal enrichment. RAFT is, and will always remain, a charity. Having a new, commercial focus gives RAFT the best chance of accelerating the introduction of Smart Matrix® around the world.

Dr Vaibhav Sharma is a scientist sponsored by RAFT who works with Smart Matrix Limited. He acknowledges the determination and focus needed to get Smart Matrix® to this stage. "What RAFT has done as a charity is unheard of. Commercialising it is a massive achievement for the organisation."

On a pragmatic level, he believes that RAFT recognises that the commercial skills needed to take a product to market are beyond the charity's means. The revenues generated will be reinvested in RAFT research, and the charity can continue to add value by focusing on transformative science.

Vaibhav's focus is firmly on managing the clinical qualities of Smart Matrix® so that it can be manufactured, distributed and used in the quantities required. "My job is to look at quality control, set the parameters of what the product is, and make sure we successfully commercialise it," he explains.

Smart Matrix® is transformational in more ways than one. It's not only changing the way surgical procedures are carried out but the way RAFT itself works. By commercialising its research, it stands to benefit millions of people around the world.

Meet the scientist: Dr Stuart Brown

"THE THING WITH SCIENCE IS YOU GET AS MUCH AS YOU PUT INTO IT"

Dr Stuart Brown joined RAFT in January 2016, after a previous postdoctoral research post at UCL's Institute of Child Health. He completed his PhD at Queen Mary University of London, researching the structure and function of a family of genes linked to psoriasis.

Can you recall your first day at RAFT?
I started and I was basically thrown in at the deep end. I was sent down to Northwick Park Hospital to look at a pig study!

So that was interesting, and wasn't something I'd ever done before. The pig work is now complete and I'm working on analysis and research for Smart Matrix®.

What's a typical day like?
I've got a series of experiments that I have planned. We have regular opportunities to set our goals, but the way you meet them is up to you. I have the freedom to dictate how I reach those goals.

The thing with science is that you get out as much as you put in, so we are all committed at RAFT.

Why do you enjoy working at RAFT?
The good thing about being in a smaller organisation like RAFT is that everyone wears lots of hats. As well as focusing on science, suddenly you may receive an email asking you to explain something to an investor who is interested in the science behind Smart Matrix®, or to take part in our famous open days.

I value the fact that I get to work in such a varied environment.

Is having a small team an advantage when developing a product like Smart Matrix®?
In my experience, adding more people to a project doesn't necessarily mean that things happen more quickly. You can often add layers of bureaucracy to a team, or specific job roles that don't necessarily add value.

Achieving the velocity to push things forward can happen just as quickly in a small team as it can in a large team. If you had 100 people working on testing a biomaterial, it would happen in pretty much the same timescale as RAFT have managed to achieve.

Is there a RAFT spirit?
There is definitely a RAFT spirit!

It's about the attitude you take towards your work. When faced with a problem, we begin to think of a solution to it. We ask ourselves whether it would work, and then we take it to the team to see what everyone thinks of it.

There is scope here to do quite a lot of different types of work to explore the feasibility of these ideas. If it works, then great. If it doesn't, then we start to look to the next idea.

At RAFT, we're always looking ahead, trying to identify the next thing that will improve the lives of patients.

Dr Stuart Brown is heading RAFT research on Wound Healing.

Meet the scientist: Dr Vaibhav Sharma

"IT'S ABOUT THE PATIENTS, AND THAT'S WHAT INSPIRES ME"

Dr Vaibhav Sharma is a postdoctoral scientist, who works on the design of quality control parameters for Smart Matrix® manifacturing. He is also involved in the translational phase of this novel biomaterial. He has worked at RAFT since 2010.

How did you find RAFT?
I've been at RAFT since 2010. I didn't know anything about RAFT before, but when I started I was amazed.

Back then we were at the initial optimisation phase of Smart Matrix®. We still hadn't cracked the right formula. We had one version of it but we were still altering it, tweaking and changing it. I was thrown in at the deep end straight away.

What do you like most about RAFT?
I love the fact that RAFT focuses on patients.

We look at the most effective ways to help them. The driving force behind us doing our work is to improve the treatment and outcomes for patients with burns. With Smart Matrix®, we are now working on testing and refining the product.

There is nothing wrong with doing scientific-driven or academic-driven research, but it's not the motivation at RAFT. It's about the patients, and that's what inspires me.

How is Smart Matrix® being developed today?
Smart Matrix® is the culmination of almost 15 years of research, to which many people have contributed. Today, Stuart (Dr Stuart Brown) and I are both working on Smart Matrix®. His skill set is completely different from mine, and we complement each other very well.

We work closely together, understanding and respecting the different roles we have. Even so, I have a huge amount of responsibility, which is beneficial for a person who has just started off his career. It's great for me to acquire all of these different skill sets.

Are RAFT's relationships with surgeons important?
They are incredibly important. We have had so many fantastic surgical research fellows who have worked with RAFT in the past, and they are generous with their time.

We always talk to them and get their feedback on products. When we were optimising Smart Matrix®, we benefited from constant feedback from surgeons. They helped identify where the problems were with our formulations, and suggested areas for improvement.

"The driving force behind our work is to improve the treatment and outcomes for patients with burns. We are now working on testing and refining Smart Matrix®."

The relationship with surgeons is also a constant reminder that what we are working on has a practical focus and will be used for patients.

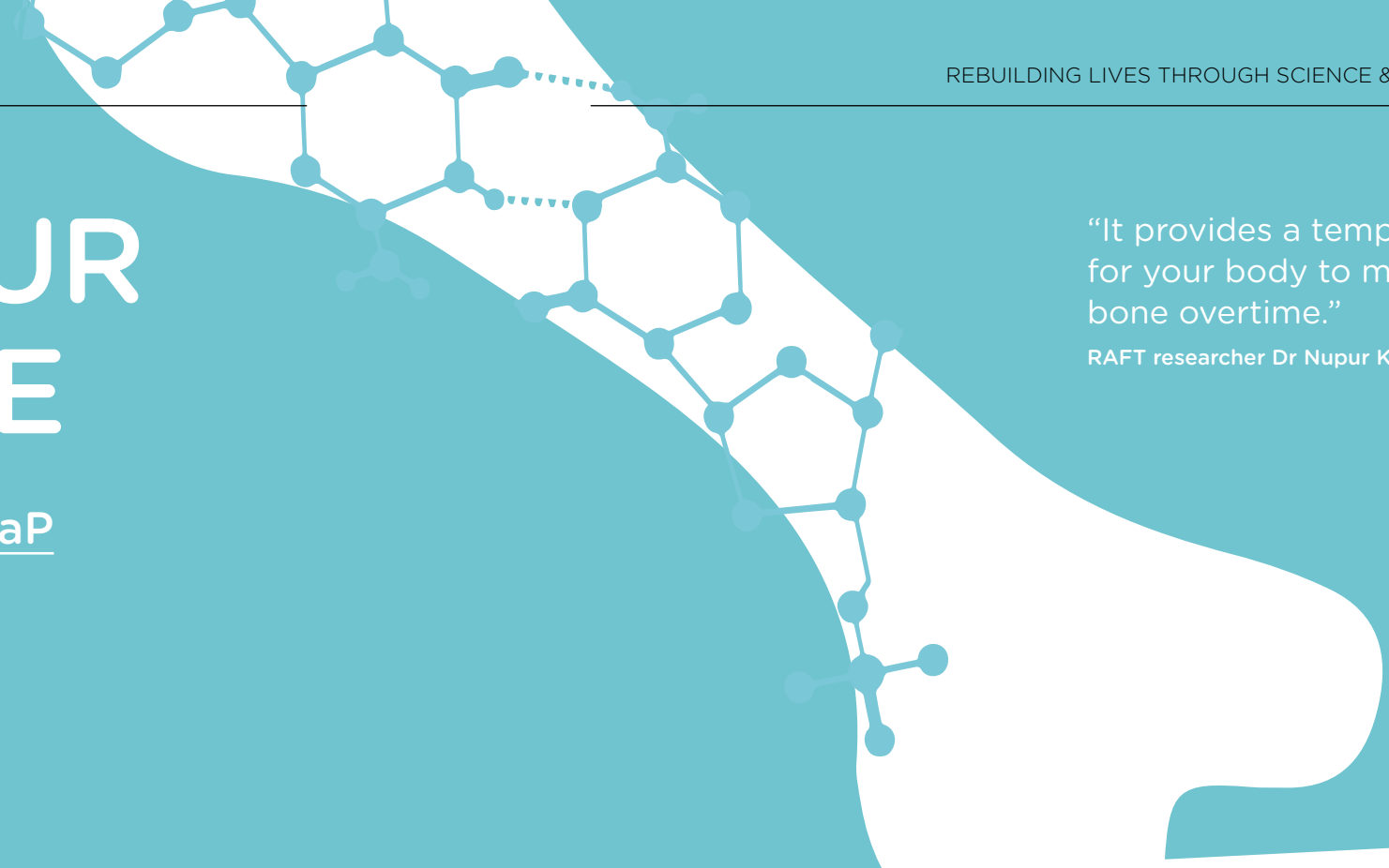
How does RAFT compare to other research organisations?
It's impossible to compare a university working on hundreds of projects to a small charity like RAFT. What you can look at is the outputs – what these organisations have achieved. In just 30 years, RAFT has made some incredible discoveries and transformed plastic surgery across the world.

If you compare us to other medical research institutes, we're in a great place. The challenge is to continue doing this for the next 30 years.

Dr Vaibhav Sharma is a postdoctoral scientist who provides significant contribution to the manifacturing of Smart Matrix.

GROW YOUR OWN BONE

A technology called Smart CaP replaces painful bone grafts.



"It provides a template for your body to make bone overtime."

RAFT researcher Dr Nupur Kohli

Bone grafting is a painful procedure that isn't always guaranteed to succeed. If bone tissue is taken from the patient's own body, it must be of high quality and taken from a non-weight bearing location. If it comes from a donor, it must be both compatible and sterile.

Fortunately, there's now an alternative to bone grafts, thanks to research carried out by RAFT. Human bone tissue can regenerate completely but it needs a supportive structure on which to grow. RAFT scientists have developed a new biomaterial composite, built from the body's natural polymers, with just those properties.

Called Smart CaP, the product has huge potential as an off-the-shelf replacement for bone grafts.

Just what could this mean to the millions of patients across the world who undergo painful bone grafts every year? "It could revolutionise the bone graft industry," she says. "It provides a template for your body to make bone overtime," says RAFT researcher Dr Nupur Kohli.

Building Smart CaP

The Smart CaP project is true to RAFT's core principles. It's about helping people with the most obvious and potentially challenging impact of trauma, illness or injury. It restores function and helps them to live full lives.

It's based on one of RAFT's most revolutionary medical advances: a wound healing treatment called Smart Matrix®. When placed on top of a wound, Smart Matrix® encourages the body to regenerate skin tissue. Made primarily from natural proteins found in the body, its porous scaffold contours to the shape of a wound. This provides a supportive structure for the body to develop new blood cells.

The success of Smart Matrix® in clinical trials prompted RAFT scientists to think about other ways the technology could be harnessed.

"When we started the project, we wanted to explore what would happen if we tried to use Smart Matrix® to grow bone," says Nupur. "Within months, we realised that we could help the human body regenerate bone by coating it with calcium phosphate."

Calcium phosphate is the primary building block of bones. Adding it to Smart Matrix® created Smart CaP – a composite material that mimics bone's molecular structure. Because it's porous it encourages blood vessels to develop, rapidly accelerating bone regeneration. Nupur and her colleagues had created the world's first biocompatible implant that stimulates bone growth.

That wasn't quite the end of the story, however. Smart CaP has a soft and flexible structure, making it a perfect replacement for skin grafts but entirely impractical as a bone replacement. The finished product would also need to be shaped to fill a hole that would normally be filled by a bone graft.

continues over

GROW YOUR OWN BONE

To overcome these challenges, RAFT teamed up with Dr Mia Woodruff, associate professor at Queensland University of Technology in Australia. Mia combined Smart CaP with robust, three-dimensional hard tissue scaffolds with the right properties to replace fractured or damaged bone.

This hard tissue scaffold enables Smart CaP to be shaped and contoured to perfectly fill any gaps. Once implanted, the biodegradable material disappears within years, and is eventually replaced by the body's own bone.

This off-the-shelf bone-void filler has tremendous potential to restore function to patients. Surgeons could use it in hip and knee replacement surgeries, to replace bone worn away by degenerative disease, and in spinal fusion treatment. "Experts are always amazed at the potential," adds Nupur.

The technology will also drastically reduce the number of surgeries required, improving recovery time for patients and saving vital funds in healthcare systems around the world.

To prove that the technique works, Nupur uses a technique originally developed in Japan. It involves growing a live chicken embryo outside the shell of an egg.

"Surgeons and scientists want to see that we can regenerate blood cell growth. Using this technique, we can clearly demonstrate the potential for Smart CaP."

"When some of the experts in the field saw photographs of the process, they said they'd never seen anything like it," recalls Nupur, smiling.

2.5 million

The number of bone grafts every year that restore function in people with bone damage or defects caused by accident, injury, disease or degenerative conditions.

Building Smart CaP

The Smart CaP project, like much of the work RAFT is currently doing, is maturing quickly. But it could still be years before it is used by surgeons. A key factor in accelerating the product's development is to establish a clear route to market – a strategy for commercialising it as quickly as possible.

"As a scientist, I want our treatments to get to patients," states Nupur. "Commercialising Smart CaP will maximise its impact."

Commercialising the technology has other benefits too, not least in helping RAFT develop expertise in an area in which many academic organisations and charities struggle.

"We've been through that journey already with Smart Matrix®. We've learned from the mistakes we made on that project, and we know we can do better for Smart CaP," Nupur says.

She believes an off-the-shelf Smart CaP product could be in clinical use within a decade, and perhaps sooner if clinical trials prove successful.

Initial trials are scheduled to commence in April 2019, marking rapid progress for the project. "I expect that we will start recruiting patients for clinical trials at the end of 2019," says Nupur. "We know that the material is safe, and the initial trials will help us generate a lot of data to support our hypothesis."

Surgery is tough and recovery long, but Smart CaP is the best opportunity for patients to play an active part in getting better.

RAFT has been instrumental in developing the technique and is one of the only institutes in the world that uses it.

Meet the scientist: Dr Nupur Kohli

"WE NEED MORE PLACES LIKE RAFT"

Dr Nupur Kohli is working on novel cell and biomaterial-based therapies for bone tissue regeneration. Her research interests include stem cells and regenerative medicine, and she completed her PhD at Aston University on stem cells and cartilage tissue engineering.

Dr Nupur Kohli is a postdoctoral research scientist in the Regenerative Biomaterials group.

How did you come to be at RAFT?
I'm originally from India. I came here at the age of 17 all by myself to study, and study is what I did!

I completed my PhD at Aston University, Birmingham with a focus on stem cells and cartilage tissue engineering. I began searching for a job and was attracted to RAFT. The job advert was about wound healing, something I didn't have a huge amount of experience in, but I thought I would apply anyway.

It's funny, because the job that I applied for became Stuart's (Dr Stuart Brown's) job. I obviously didn't get that job, but they were very happy with my interview and said that there was a vacancy in the bone project.

Do you enjoy working at RAFT?
I love it here.

I really value the autonomy. I feel that this is my project and I have to take it forward. I'm not competing with anybody.

Personally, I feel that working this way brings a greater sense of satisfaction because I feel like I'm in charge of this project. I'm responsible for everything I do. It certainly keeps me on my feet as well.

What makes RAFT unique?
One of the biggest benefits of being at an organisation like RAFT is that it is structured differently to anywhere else.

In academia, there is pressure to bring in the money through research grants and funding. It's about generating revenue, not always research. You're supposed to make sure you're out there and that people know you.

At RAFT, we're active at local and international conferences, sharing our research and representing the organisation as a medical research charity. But we can focus on the science and let the rest of the team worry about the money.

You seem to value the contribution of the entire team.
I do. The fundraisers do an excellent job of bringing in money, which means the majority of our time is spent focusing on the research, being in the lab, or thinking about our projects.

Do you collaborate with the other scientists at RAFT?
Absolutely. We often discuss techniques and experiments that we are doing. Working with the scientific team here is fascinating, because everyone is so committed and experienced. It's valuable to be able to share ideas and discuss them.

It's another benefit of being at a place like RAFT where you can be a bit more relaxed about your work, free a little from the commercial pressures of industry or academia. You aren't afraid to share an idea.

Your project is following in the footsteps of Smart Matrix®. Has the journey of that product helped you?
Incredibly, yes.

Smart Matrix® has progressed a long way on the journey to commercialisation. We can learn from the challenges they have faced, and tackle them earlier in the Bone Regeneration project.

The time invested in Smart Matrix® and the expertise in the team will hopefully make the process more efficient, and potentially a bit quicker too.

What will RAFT be like in 30 years?
I truly think that organisations like RAFT are the future of medical research charities. We need more places like RAFT, because as scientists we want our research and treatments to get to patients. In 30 years' time I expect RAFT to still be here, but I hope others follow in its footsteps.

PUTTING SMILES BACK ON FACES

RAFT scientists are using 3D printing and new biomaterials for facial reconstruction.

RAFT research scientists:
Nazanin Owji, Dr Elena Garcia
Present collaborators:
UCL Eastman Dental Institute

Smiles communicate more than just happiness – they display our humanity. But for anyone born with jaw abnormalities or the victims of serious accidents, smiling may be nigh on impossible.

That's why RAFT, in collaboration with the UCL Eastman Dental Institute, is developing a 3D-printed implant to help rebuild their faces. Based on 3D scans, the project aims to produce implants that are unique for every patient.

The research addresses the two key challenges of facial reconstruction surgery: the need to restore movement and the importance of restoring the unique shape that gives us our identity.

"We focus on both aesthetics and function. We want to help people smile again," says RAFT scientist Nazanin Owji.

Every year, over 2 million people around the world, including 60,000 in the UK, undergo craniofacial surgery. The surgery involves rebuilding the lost portion of the face with an implant. It can be a lengthy process and infection is a risk.

Craniofacial surgery has traditionally focused more on restoring function than aesthetics, with implants made of bone, titanium or other synthetic materials. Bone implants are difficult to shape and can be rejected by the body, as can titanium implants.

Titanium may look good, but implants made from the material can be stiff and uncomfortable. There's an additional risk of metal toxicity if it corrodes, and both titanium and bone implants can work loose.

For children and teenagers, synthetic implants present another problem. Since their bodies are growing, they'll need multiple operations as they get older to replace implants that no longer fit.

Nazanin believes there's a better way. "The human body is smart enough to regenerate that tissue as the child grows up. What we need to do is find the right material, which will encourage the growth of human bone," she says.

That's exactly what the RAFT project is doing. It's developing a biomaterial that encourages the body to grow its own bone, removing the risk of rejection. Moreover, the biomaterial forms an implant that's exactly the right shape for the patient's face because it's produced by a 3D printer.

The technique of 3D printing has enormous promise for creating accurate shapes in the field of biomedicine.

But scientists have, until now, been limited by the types of material it's possible to print.

RAFT's biomaterial is based on existing compounds, known as light curable methacrylate-based polymers, developed by the UCL Eastman Dental Institute. Researchers are currently exploring the effect of adding calcium phosphate, which forms the building blocks of human bone, along with other substances.

The big advantage of the implant is that it isn't solid. Rather, it forms a scaffold, and it's this platform that encourages the body to grow new bone tissue.

The implant is also biodegradable. As blood vessels form and new bone tissue is established, it wears away and is eventually absorbed by the body. "The material will degrade within six months, encouraging the formation of new tissue," says Nazanin.

continues over

PUTTING SMILES BACK ON FACES

How it's made
To ensure the implant is precisely the right size and shape, digital models are first created from MRI and CT scans of a patient's face.

The results are sent to a pressure-based 3D printer, which squeezes out the biomaterial compound. The polymer is extruded through a syringe, building layer upon layer to form a rigid, but porous, structure that can later be implanted in a patient.

As the material comes out of the printer it's immediately exposed to UV light, which hardens it. After 20–30 seconds, what was a liquid is now a solid.

Developing this part of the process proved a challenge for Nazanin, who is an expert in 3D printing. "If you look at a normal 3D printer, you can see that it works very fast. But we have had to adapt our computer program to slow the process down," she explains.

Despite this being one of RAFT's most exciting and complex projects, the development time frame is surprisingly short. In vivo trials are scheduled for 2019 and, if successful, Nazanin believes pre-clinical trials are a possibility for later that year.

If all goes well, biodegradable 3D-printed facial implants could be a reality within 10 years. This would be music to the ears of medical practitioners around the world," Nazanin says. "Surgeons are in love with this project. I've been told many times that this product is urgently needed in the clinic."

For Nazanin, the value comes not just from restoring smiles today, but from helping patients smile for the rest of their lives. The best way to make this happen is to help the body to heal itself, she says. "It really is the definition of personalised medicine."

Nazanin Owji,
Dr Elena Garcia

"If you look at a normal 3D printer, you can see that it works very fast. But we have had to adapt our computer program to slow the process down."

Meet the scientist: Nazanin Owji

"I BECAME FASCINATED BY THE POTENTIAL FOR REBUILDING HUMAN TISSUES"

Nazanin Owji is working on the development of a 3D-printable composite that can be used to rebuild faces damaged as a result of disease, injury or trauma.

How did you come to find yourself at RAFT?
When I was doing my Masters at UCL, I came across RAFT and was very interested in its focus on wound healing and skin regeneration. I thought to myself that this research institute sounds very interesting, and its focus on translational research sounded amazing.

I was aware – even then – that not many places in the world work in this way. It was something I wanted to be part of.

Why were you inspired to work on this project?
During my education I focused on biomaterials and tissue engineering, which is very close to what we are currently doing here. In fact, it's practically the same.

The 3D facial reconstruction project is a joint project between the UCL Department of Biomaterials and Tissue Engineering at the UCL Eastman Dental Institute and RAFT. I'm currently in the second year of my PhD, and spend half of my time at RAFT and the other half at UCL.

During my Masters degree, I became fascinated by the potential for us to be able to rebuild human tissues. I spent some time working on 3D printing techniques and technologies, which have helped me with this new project.

RAFT focuses on translational research. Is this something that excites you?
Absolutely. I wanted to focus on a project that I could see getting to the clinic in the next 10 years. I really want this to change lives.

What do you feel makes RAFT unique?
Working at RAFT is like being part of a family. Because of the collaborative nature of the project, I spend half of my time at UCL but I always look forward to spending a few days here.

The dynamic here is very different. We are all so close, and we are all working towards the goal of improving things for patients. That makes RAFT unique. It's not just the science – we are all aware of the history of RAFT and are working towards making it better as an institution.

As a PhD student, how does RAFT compare to other institutions?
It's impossible to compare them but I think RAFT is a unique place in many respects. I think the opportunity I have been given here is amazing. It's actually incredibly rare for a PhD researcher to be given the freedom I have been given.

In practice, it means that I'm not limited or constrained by the ideas of others. I can have an idea and then I can see if I can make it happen.

What is it that you most enjoy about working here?
One of the good things about RAFT is that we tend to have a lot of interaction. It's not just sitting in the corner of the lab doing your own research. We have a lot of events where we get to meet sponsors, patrons and patients.

RAFT teaches you to be proud of what you're doing and talk to it about people, because it is essential that people understand the incredible work that we do here.

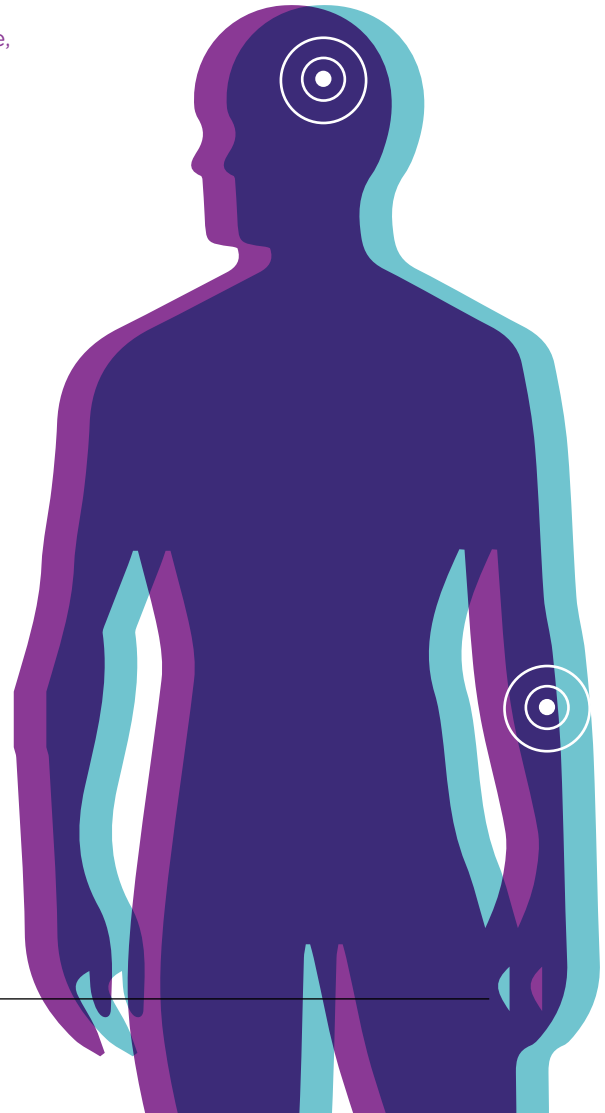
Nazanin Owji is a PhD student and is leading the 3D facial reconstruction project in collaboration with University College London (UCL).

BUILDING A BIONIC HUMAN

Intuitive, bionic prosthetics will restore movement and function to people with upper limb amputations

RAFT research scientist: Dr Norbert Kang and Dr Yazan Al-Ajam

Present collaborators: Anne Vanhoestenberghe, University College London (UCL)



When your arm reaches down to pick up a pen, your brain sends thousands of signals to your nerves and muscles. We perform similar movements thousands of times a day without realising the incredible complexity involved.

These are actions that even today's most advanced prosthetics can't fully emulate. But RAFT is aiming to make tomorrow's prosthetics as intuitive as real limbs. It's investigating how to capture signals from muscles and nerves and translate them into motion.

The potential for truly intuitive prosthetics is enormous, providing people who have lost limbs with much greater freedom and control. Says plastic surgeon Dr Norbert Kang: "Think of [actor] Lee Majors in *The Six Million Dollar Man*. Ultimately, that is what we're going to get to."

Problems with prosthetics

Thousands of people with upper limb amputations use prosthetics every day. Prosthetics restore at least some of the function lost as a result of accident, injury or disease. But it's widely acknowledged that they can be unreliable, impractical and difficult to use.

Typically, a prosthetic arm is joined to the body at an amputation stump with sockets, straps and harnesses. They're often difficult to attach and can chafe and cause discomfort, which can lead to infection and ulcers.

Current prosthetics use electrodes placed on top of the skin to translate the signals generated by the body's muscles into movement. This is how your brain instructs your limbs to move, controlling your body with an incredible level of sensitivity. When you pick up a pen, the motion isn't linear but the combination of a variety of muscles pushing and pulling in unison.

However, the translation of these signals is limited in current prosthetics. Electrodes are able to interpret only some – but not all – of the signals. Users may get back some of the function they had before the amputation, but with far less flexibility and complexity than we expect from our bodies.

"It's investigating how to capture signals from muscles and nerves and translate them into motion."

Reproducing the complexity of normal upper limb movement isn't the only issue that users of prosthetics may face, says Norbert. "Any stray radio frequency wave can amplify the signal. It can make the prosthetic move uncontrollably and without warning." This can be embarrassing at best and, at worst, potentially dangerous.

Building the limb

To improve upon the current generation of prosthetics, Nobert is leading the CAPITel project, a collaboration with University College London (UCL) that's funded and managed by RAFT. CAPITel aims to develop and trial two sensor systems. Placed within the patient's body, they can detect "the electrical discharges produced by contracting muscles, and translate them into movements of a prosthetic limb", explains Norbert.

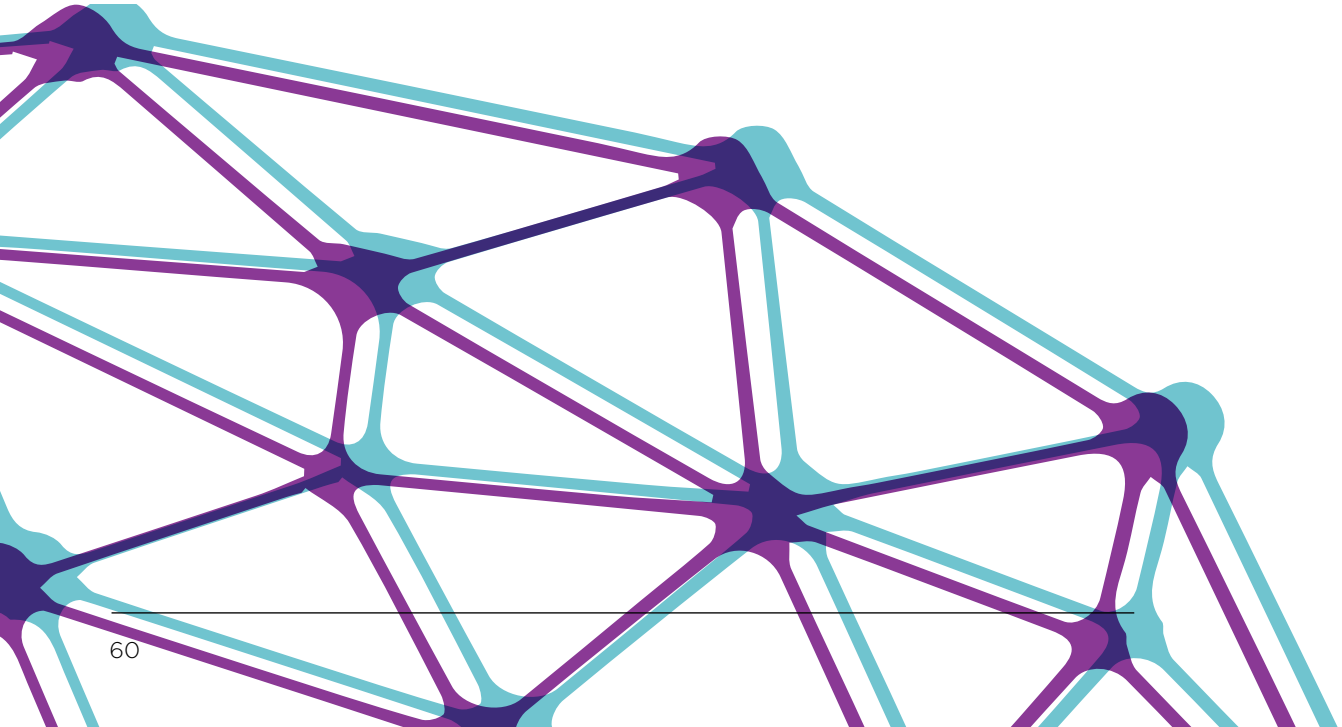
To replicate even simple movements in an artificial limb, the prosthetic needs a processor capable of capturing information from a variety of sources, or 'channels'.

"We've tried to capture a lot of channels of information, and it's complex," says Anne Vanhoestenberghe, the lead scientist working on the project at UCL. "We want to be able to process 4–6 channels of information above the elbow, which will allow us to restore a good level of movement."

Once captured, the muscle signals must be transmitted to the prosthetic limb. Existing prosthetics use electrodes and wires placed on top of the skin for this purpose. However, these restrict natural movement and often fall off due to sweat. Instead, the CAPITel project is developing two different systems to allow users to interface seamlessly with their prosthetic limbs. The two systems transmit the signals in different ways. The first employs a wired connection through the bone, and the second a wireless Bluetooth or radio-frequency link.

Testing both systems will help researchers understand which is most effective, using this as the basis for further development of the technology.

The signal transmission system is just one part of the package. A converter is required to turn analogue movements of the muscle into digital information. The converter then feeds a microcontroller, which processes the raw information and turns it into the instructions for motion.



Collaborative approach

The challenge is to develop a device that is strong and secure enough to be implanted in the body. It needs to be highly efficient, drawing as little power as possible. And also small. The microcontroller will be about 2cm x 3cm, a challenge given that it needs to capture at least 20 separate connections.

Despite sounding like science fiction, some of the technology is almost two decades old. Anne says "We're taking a lot of know-how and innovative ideas from other devices to create a small device that can record the muscles we want to focus on. The technology exists today. If there was a large market for it, some company somewhere would already be doing it."

The project has been a focus for RAFT since 2015 and has enjoyed rapid progress thus far. "We know that this approach will work – we have been talking about it for over 10 years," adds Norbert.

There's still more work to do, with Anne committing to at least three iterations of the device before it is ready for human trials. The technology will soon be tested in animal models, and tests in humans are a realistic goal within the next five years.

When RAFT's work is complete, prosthetic limb manufacturers will still need to create devices that can translate these signals into movements. But by then, much of the heavy lifting will have been done.

At that point, the technology developed by RAFT and UCL may not be the only such system on the market. But despite similar technololgy having been developed in Sweden, Norbert isn't worried about being left behind. "There's nothing like competition to drive the evolution of technology!" he says.

"The aim of RAFT is to fund and support research that will restore the appearance and function of patients. This research ticks all the boxes."

As one of the originators of biomechanical engineering, how does Norbert see his work in the context of RAFT's proud history? "The aim of RAFT is to fund and support research that will restore the appearance and function of patients. This research ticks all the boxes."

Anne Vanhoestenberghe,
Dr Yazan Al-Ajam

Meet the scientist: Dr Norbert Kang

"RAFT HAS BEEN CENTRAL TO MY LIFE AND CAREER."

Norbert Kang graduated from Charing Cross and Westminster Medical School in 1989. He did his MD fellowship at RAFT from 1995 to 1997, completed his plastic surgery training at pan-Thames, and became a consultant in 2002. He has special interests in hand surgery, hypospadias surgery, prosthetic reconstruction (upper limb) and prominent ear correction.

Present collaborators: Dr Anita Mohan

Can you explain how you came to RAFT?
I started working at RAFT as a surgical research fellow in September 1995. I was appointed to work on a project to select an antibody fragment to detect metastatic melanoma. The Leopold-Muller building had just been completed after eight years of fundraising. Until that point, any research was being carried out at the Gray Laboratories (now closed and relocated to Oxford), and we surgical research fellows were tolerated as paying "guests".

I was the first surgical research fellow to carry out any science in the new building.

What was your first day like?
I remember clearly the excitement of having to stock the shelves in the newly opened laboratories with equipment and chemicals to make the science happen. Like anything new, the excitement was infectious and we were all highly motivated. It seemed like there was a new face in the building every week and it felt very much like being part of a family – but a family with a purpose.

The project went well and was completed in two years (with an additional three months for the writing up stage). At the end, I submitted the research for an MD degree from the University of London, which was awarded in November 1998.

That's almost 20 years ago now. Why have you continued to stay involved with RAFT?
Because what we do matters to lots of people. After my departure from RAFT, I made a conscious decision to continue my links with the institute. This initially involved me supervising other surgical research fellows, and since February 2013, as a trustee.

What is it like working with RAFT?
RAFT used to be a bit of a finishing school for plastic surgeons in the UK. Now, in common with all UK charities, it has faced a bit of a rollercoaster ride owing to the difficulty of raising money and the need to persuade donors that we observe strict governance rules. All institutions go through ups and downs but I remain optimistic for the future of the institution.

What sets RAFT apart from other charities or academic institutions?
RAFT is unique because it is small and is focused on supporting areas of research related to plastic surgery only.

What has RAFT meant to you and your career?
I got my MD doing a project at RAFT. I met my wife while doing my MD – something that would not have happened had I not been living in Northwood. I got my registrar job on the strength of my MD and I got my consultant post on the strength of my involvement with RAFT.

RAFT is 30 years old. What message would you give to those interested in what we do?
RAFT lives and thrives. RAFT matters. Get involved and support us.

A former surgical research fellow, Dr Norbert Kang is leading the intuitive bionics project and has been a trustee of RAFT since 2013.

REBUILDING A LIFE AFTER MASTECTOMY

A natural implant lessens the surgical and psychological impact of breast removal.

Present collaborator: Dr Anita Mohan

Inspired by the experiences of women recovering from a mastectomy, RAFT is working on a biologically sympathetic breast implant. It looks and feels like real breast tissue and is based on stem cells – a world first.

"The implants we are creating are not only aesthetically and physically pleasing, they are 100% natural," says RAFT scientist Dr Prasad Sawadkar.

The impact of the new implant could be enormous. About 1.5 million women suffer from breast cancer, the most prevalent form of cancer in the world. And more than 40% of breast cancer patients undergo a mastectomy, including 23,000 women a year in the UK, to stop it spreading.

It's not just women diagnosed with breast cancer who undergo this surgical procedure. Women with an increased genetic risk of breast cancer, including the film star Angelina Jolie, have taken the difficult decision to have a mastectomy to prevent the disease.

The surgery is undeniably clinically effective. It removes the current and future risk of cancer but it's also life-changing. It can have a dramatic impact on the sense of identity and emotions of those who experience it, and many women feel that a core part of their identity has been removed.

The problem with implants

It's not surprising that around 40% of women suffer from depression after a mastectomy, as they struggle to adapt to life after surgery.

But for many, the biggest issue with synthetic breast implants is that they don't look or feel normal. What's more, the procedure to implant them isn't without risk. The recent crisis involving silicone implants made by French company PIP is a vivid illustration of the problems women can experience.

"We know that if we put something artificial into the breast, it's not going to survive," says Prasad. "The core concept of the life after breast cancer project is to create an implant made of something the body already has."

So-called 'free fat breast implants' use fat harvested from the patient's body to reconstruct a natural-looking breast. While these are initially successful, up to 90% of the fat can be reabsorbed by the body over time.

So RAFT research has focused on adding stem cells to free fat transfer breast implants to improve the procedure's success rate. Stem cells can generate other types of cells: adipose-derived stem cells have the potential to form new tissue and repair the body.

Research at RAFT has established that they also have the potential to dramatically slow, or stop, the absorption of fat within breast tissue. By harvesting and purifying adult adipose stem cells, RAFT aims to isolate only those stem cells that help store fat.

To do this, research is focusing on two areas. The first involves perfecting the process of harvesting adult adipose stem cells, for which laboratory work has now been completed. The second involves combining these stem cells within a three-dimensional scaffold to ensure that the supplemented fat stays in place.

continues over

REBUILDING A LIFE AFTER MASTECTOMY

A new kind of implant
The new implant can be put in place at the same time as the patient is undergoing a mastectomy. “By combining the procedure, you minimise the impact on the patient and reduce the amount of time the patient spends in surgery,” Prasad says.

The breast tissue that’s removed is instantly replaced, so the patient enters and leaves the hospital looking the same. The psychological impact of a mastectomy is reduced.

“With our implant, after the single procedure, women can continue with their lives,” says Prasad.

What’s novel is that the implant can, over time, become part of the patient’s body.

The research has enjoyed the support of a host of ex-RAFT surgeons and fellows – all of whom are willing to give up their time to ensure the product is right. “If there’s an issue to be solved we speak to them, and they provide a solution that works with our design,” he says.

Has the input from plastic surgeons accelerated Prasad’s research? “Yes, because ultimately the product is going to surgeons. We have ex-RAFTers who are surgeons – mostly plastic surgeons – who are working with breast implants,” he says.

The new research with stem cells isn’t RAFT’s first involvement in breast reconstruction surgery. Research by the charity has previously helped improve the success rate of a type of breast reconstruction surgery called free-flap transfer. The procedure accounts for 20% of all breast reconstruction operations in the UK.

Free-flap transfer breast reconstruction involves transplanting tissue from another part of the patient’s body. Blood vessels in the transplant are joined to those in the reconstruction site to re-establish blood flow. A good blood supply is vital to ensure that the transplanted tissue survives.

Unfortunately, one in ten free-flap transfers fail due to complications. If the blood supply isn’t good enough, clots can prevent blood reaching the flap or the flap can become congested. As a result, the tissue can die and the patient can suffer from delayed healing as well as pain and scars both physical and emotional.

RAFT carried out experimental work to solve these problems with the procedure. It developed real-time imaging techniques to track blood flow in the prospective transplant tissue. This allowed surgeons to identify tissue with the best possible blood supply.

The research also involved developing methods to increase blood flow in the proposed tissue prior to the transplant procedure. By boosting the blood supply, the transplanted tissue has the best possible chance of survival.

Losing a breast, and undergoing reconstruction surgery, is a sad fact of life for millions of women around the world. But RAFT’s pioneering research into breast reconstruction at least offers hope that, in future, the social stigma and emotional impact of mastectomy can be reduced.

Dr Anita Mohan

Meet the scientist: Dr Prasad Sawadkar

"THE GOOD THING ABOUT RAFT IS THAT THEY NURTURE US"

After stints studying at both University College London (UCL) and Harvard Medical School, Dr Prasad Sawadkar is now a postdoctoral research associate for the breast reconstruction after cancer programme.

How did you end up at RAFT?
I have medical background. After a Bachelor's degree, I completed my PhD in surgery at University College London. In 2015, I moved to Harvard Medical School for a year, and there I specialised in clinical studies.

When I returned to the UK, I just happened to see an advert for the position at the breast reconstruction project at RAFT and applied.

Why did you apply?
I was inspired to apply because, while we know what breast cancer is and how to treat it, very few people are focusing on what life is like for those people after they have had cancer. The project immediately captivated me.

I know, as a medical specialist, that if you remove the breast, you can get rid of the cancer. But the psychological impact on a person is very, very strong. I wanted to help women reconstruct their social identity after the life-changing trauma of breast removal.

What do you enjoy about working at RAFT?
I like the concept of RAFT; its focus and commitment to improving lives. I also love the way that the organisation works. I appreciate that I have the freedom to think outside the box here. There is no one to tell me what to do. It's very different to academia where you have a boss who directs the research themes.

How does that freedom work in practice?
At RAFT, I have been given the chance to make my own decisions. I began the project from scratch, taking it in my own direction. Of course, there were false starts and failures, but the process is really beneficial for me, and has allowed me to grow within myself as a scientist and as an individual.

The good thing about RAFT is that they nurture us, which in turn gives us the freedom to nurture our own ideas.

Has this approach helped with the breast cancer project?
Definitely. The breast reconstruction project I'm working on is a very, very ambitious project for RAFT. We're doing something that hasn't been done before, so having the freedom to follow my own ideas allows me to be creative with solutions.

RAFT has incredibly strong relationships with plastic surgeons, many of whom work with breast implants. Being able to speak to them, ask them questions and learn from them allows us to refine the design of our solution into something that will work.

As someone who has worked in industry and academia, what makes RAFT different?
At RAFT we are a bit more relaxed. We don't have to go through the continual cycle for finance, which allows us to focus on what matters: our research.

We all have a clear idea about what we are doing and we have some fantastic people to support us behind the scenes, raising money and helping us.

It's a very positive and productive thing for a scientist to be in such an environment, and it creates better science. It make the process more efficient, and potentially a little bit quicker too.

Dr Prasad Sawadkar wants to help women reconstruct their social identities after the trauma of having breast removal.

WHAT RAFT MEANS TO ME

Peter Gordon

"When I was seven, I tipped a deep fat fryer on my head," says a matter-of-fact Peter Gordon. "I was helping my father cook dinner."

The horrific injuries Peter sustained required a skin graft and a year of hospital treatment. Peter's experience is tragic, but it hasn't defined his life. "I've never been worried by my burns actually," he says.

Peter's career has seen him open award-winning restaurants in his native New Zealand and now London, splitting his time between the two countries. He's taken inspiration from both and channelled it into his unique blend of fusion cuisine. A modest man, Peter has raised an incredible £6 million for charities, and he's not finished yet.

Stepping into the Mount Vernon building, with a typically Antipodean lack of tact, he sums up what he's thinking: "This here looks like a garden shed – a two-storey garden shed. It's hilarious, and yet they are changing millions of lives."

"There are people for whom science is just a total turnoff and then there are geeks and people like myself who just find it so fascinating," he says, while enjoying a tour of the building.

Reflecting on a demonstration of Smart Matrix®, Peter is impressed with what he has seen: "I know a lot of science is incredible and produces so many things, but just holding that thing [Smart Matrix®]... It looks so simple but it's taken, as far as I know, 10 or 12 years' research to get it to this point."

As someone who has lived with the impact of burns, what would it mean? "It will be life changing," he says.

Smart Matrix® could also be used to help the thousands of people – the majority of whom are women – who are injured and disfigured by acid attacks. "You imagine people around the world who will benefit from this thing that's come out of this garden shed..." he says, tailing off as he ponders the possibilities.

He adds: "I love the way that RAFT has found a way to carry out all of these trials without getting a penny from the government. It's like a commercial medical enterprise."

As RAFT celebrates 30 years, what does he know about the charity's past? "It's particularly British..." he says with a smile. "There were some very eccentric characters."

And what about the scientists and researchers he has met today? "I have nothing but admiration for them. I think they are remarkable."

Nicknamed the 'godfather of fusion food', Peter Gordon's international restaurant empire stretches from New Zealand to the UK. He is a passionate supporter of RAFT.

5 PAPERS THAT HAVE CHANGED THE WORLD

SHARING SCIENCE AND IMAGINATION THROUGH RESEARCH

Elena Garcia, RAFT's director of research, chooses the five papers that have helped to establish RAFT as a centre of research excellence.

Dr Elena Garcia

1. Laser-assisted hair removal: Liew et al. 1999
Published in the journal *British Journal of Plastic Surgery*, this was one of many papers by RAFT in the area of laser-assisted hair removal. In the report, RAFT scientists presented a prospective clinical study of 71 patients on scalp-skin hair regrowth. The results showed the usefulness of laser-assisted hair removal for aesthetic purposes. A ruby laser not only permanently destroyed some hair follicles but also reduced the coarseness of regrowing hairs. It suggested that this could improve the appearance of hirsutism, a condition of unwanted, male-pattern hair growth in women.

2. The nature of hypertrophic scarring: Linge et al. 2005
This study by Linge and co-workers, published in the *Journal of Investigative Dermatology*, investigated the inability of fibroblasts (cells involved in the wound healing process) isolated from hypertrophic scars to undergo a type of apoptosis (programmed cell death) that cells found in normal scars would do. Timed apoptosis is key to achieving the normal repair of wounds and when it fails, it can result in a hypertrophic scar. The study alaso shed light on the exact triggers of apoptosis during normal wound healing, which still remain unclear.

3. High intensity UV radiation and skin cancer: Haywood et al. 2011
This paper revealed that high-intensity UV radiation, as experienced in hot countries or sun beds, induces free-radical damage to human skin, DNA, lipids and proteins. Using electron spin resonance spectroscopy to measure free-radical generation in human skin, it showed that damage at high intensities is part-cellular and part-extracellular, and that skin substitutes are suitable for testing sunscreen. The research was pivotal for the introduction of new recommendations regarding sunscreens, which should protect against a wide range of UV radiation.

4. Bone regeneration: García-Gareta et al. 2015
This review paper was the first publication in RAFT's history to focus on bone regeneration – now the largest research programme at RAFT. The publication reviews and discusses osteoinduction, the process by which stem cells are stimulated to differentiate into bone cells, thus producing new bone tissue. Autologous bone grafts used by surgeons are osteoinductive, which makes them very effective at regenerating bone. Synthetic bone grafts developed to overcome the pain and limited availability of autologous grafts should ideally be osteoinductive too. This publication reviewed the literature to date about the phenomenon. Published in the journal *Bone*, it has had over 110 citations, making it one of the most cited reviews in the field.

5. Smart Matrix™ and cells: Sharma et al. 2016
Of all the papers on Smart Matrix™, this stands out due to its systematic comparison between Smart Matrix™ and its main competitor, Integra. The paper showed that there are differences between both dermal scaffolds in terms of structure and mechanical properties. These may explain why Smart Matrix™ shows a higher infiltration of cells in vitro and in vivo. The paper was published in *Biomedical Materials* and introduced Smart Matrix™ as a new-generation material compared to Integra. It also called attention to the importance of material design to maximise cell response.

WHAT RAFT MEANS TO ME

Hina Solanki

One of the UK's most highly respected micro-pigmentation specialists, an author and entrepreneur, Hina Solanki is a keen patron of RAFT, helping to promote the work it does.

"My job is really to just make things look as normal as possible, or camouflage things."

The reason I was so interested in RAFT is that our goals and mission are very much the same," says Hina Solanki. "It's about changing lives and building confidence in people."

Hina is a micro-pigmentation specialist, which involves using cosmetic techniques to create permanent or semi-permanent improvements to those who are recovering from disfigurement or injury.

It's a varied field, which means no two days are the same: "I rebuild areolas, possibly after breast cancer for victims; I will help people with burn scars and those who've been in accidents," she explains.

Many of her patients will already have undergone some reconstructive surgery, she says, "after the surgeons have really done their magic." It's at this point that her work begins.

"They'll have gone through their surgery but there's still the cosmetic look, the aesthetics, and that's my job – to improve the aesthetics." For those with burns and injuries, or after life-changing surgeries like a mastectomy, Solanki's work is about helping to "improve the confidence and well-being of a person."

After suffering a health scare in her 30s, Hina has dedicated her career to helping patients build a life after surgery. Initially attracted to RAFT after learning about the innovative work on breast reconstruction, she is now a passionate advocate for everything that RAFT does.

An avid social media user, with thousands of followers across the world, Hina is keen to raise awareness of the work of the charity, using her platform to raise awareness of the work we do.

"This is about people," she says. "The magic is invented here and that's why I'm interested in RAFT."

For research to have an impact, it needs to get to patients

"There is affinity between biology and business. In each of them it's about the survival of the fittest."

Cherie Blair, CBE

Since the beginning of RAFT, research has focused on delivering clinical innovations that benefit patients. The organisation has concentrated on listening to what surgeons and patients want, creating solutions that help people rebuild lives after physical trauma.

In 30 years, RAFT has established itself as an institution with global importance and worldwide impact. Over 100 RAFT projects are in use today, helping those recovering from life-changing injuries to look forward to a better future.

The founders of RAFT were dismayed at the time it took to translate research from the bench to the bed, and so they did something different. It's this spirit that remains and is directing the work of RAFT today.

To survive, charities need to adapt and RAFT is no different. The organisation us taking the bold step of becoming partners in the commercialisation of its research. It's about building new brands and businesses that can accelerate the spread of innovations, because patients shouldn't have to wait.

A smarter approach
RAFT receives no Government support. Instead it generates revenue through funding grants and the generous contributions of fundraisers. For every £1 raised, 75p is spent on research, which makes RAFT one of the UK's most efficient charities. But it's not enough.

Scientists and leaders recognised early in the development of Smart Matrix® that it could have the potential to radically improve wound healing across the world, giving patients with full-thickness burns and injuries the chance to make a full recovery – but only if it could get to those patients who need it.

The increasing cost of developing new treatments, and the desire for RAFT to have a global impact, is challenging the organisation to think differently.

In 2011 RAFT created Smart Matrix Ltd, a spinout company created to develop and commercialise the product. RAFT and Smart Matrix Ltd are separate entities, with a licence agreement between the two that formalises the relationship. RAFT are shareholders, with the CEO being in charge of directing both organisations for the first five years.

The money generated from Smart Matrix® and any new commercial projects will be used to fund the work of RAFT now, and in the future. Every penny will be reinvested by RAFT in the development of new innovations, building on these successes to change more lives.

To continue on this journey – and change the most lives – RAFT recognises are ofcusing on developing more collaborations and partnerships. They're working to connect with those outside of science, including patent attorneys, regulators, bankers, lawyers and marketers.

As an organisation, RAFT also needs to change. The development of Smart Matrix Ltd is helping to shape the charity's approach, providing a blueprint for the future.

Strategically, RAFT needs to become more agile, commercially focused and clear on where it can add value. The strategic work is helping shaping the organisation for another 30 years, transforming lives across the world.

COLLABORA TION & COMMERCIA LISATION

THANK YOU TO OUR NOTABLE SUPPORTERS

Patrons:

HRH The Duchess of Kent

Mr John Apthorp CBE, OBE
Dame Mary Archer
Cherie Blair CBE, QC
Olivier Branford
Jon-allan Butterworth MBE
Ron Dobson, CBE, QFSM
Peter Gordon
LT COL Steven Jeffery, BSC MB CHB FRCS (PLAST)
Bob Jenkins
Clover Lewis
Ms Ellie Lindsay OBE
Ms Sandra Mcclumpha
Dame Siân Phillips DBE
Richard Richards
Hina Solanki
Ferrial Syed
The RT HON Lord Tebbit CH

Trustees:

Jonathan Angell
Alison Baker
Niccolo Caderni, Chairman
Norbert Kang MBBS MD FRCS (PLAST)
Rob Pinchbeck
Chris Scott OBE
Richard Williams
Dafydd Wright

Scientific Advisory Committee:

Dr Umber Cheema BSC. (HONS), PHD
Professor Chris Mason MD PHD, FSB, FRCS
LT COL Steven Jeffery BSC MB CHB FRCS (PLAST)
Professor Steven Myint MD PHD
Professor Kevin Shakesheff PHD, FRPharmS

THANK YOU

We want to thank all our volunteers, donors and supporters who have accompanied us through this incredible journey. We count on your renewed commitment to RAFT's excellence in delivering research results for everyday living.

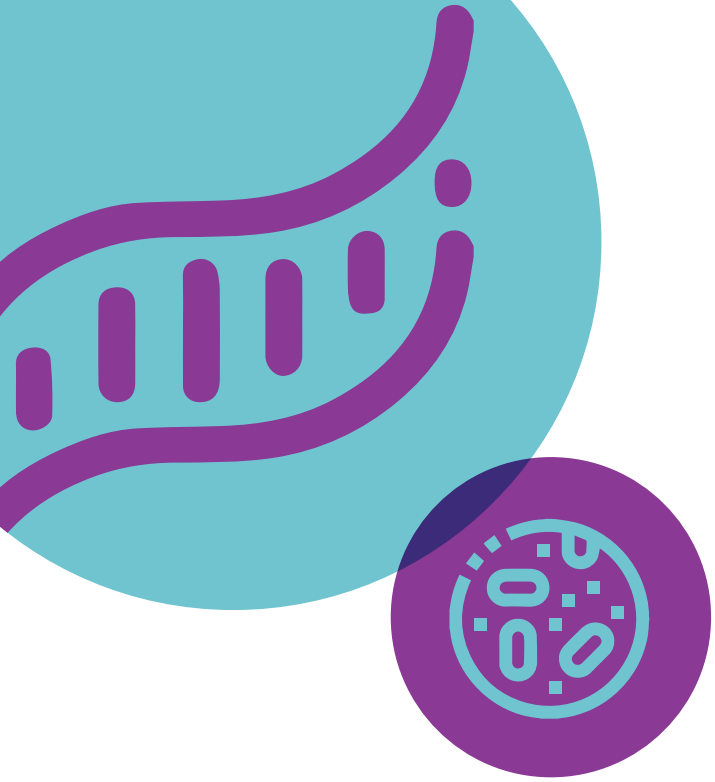
raft

Can you help?
As a charity we rely on the generosity of our patrons and supporters to continue our life-changing work. If you would like to support RAFT in any way then please contact us today.

Call us: 01923 844760 / 01923 844588
Email us: charity@raft.ac.uk
Write to us: Leopold Muller Building, Mount Vernon Hospital, Northwood, Middlesex HA6 2RN

Learn more about how science and imagination is changing lives at: www.raft.ac.uk

Publication Details:
Written by: Lawrie Jones
Designed and produced by: 42group
First edition published in 2018.



raft

Can you help?
As a charity we rely on the generosity of our patrons and supporters to continue our life-changing work. If you would like to support RAFT in any way then please contact us today.

Call us: 01923 844760 / 01923 844588
Email us: charity@raft.ac.uk
Write to us: Leopold Muller Building, Mount Vernon Hospital, Northwood, Middlesex HA6 2RN

Learn more about how science and imagination is changing lives at: www.raft.ac.uk