Australian Human Rights Commission

Inquiry into the treatment of individuals suspected of people smuggling offences who say that they are children

Transcript of public hearing for key medical experts

9 March 2012

[START OF TRANSCRIPT]

Catherine Branson: Thank you, everyone. I think it's close enough to nine o'clock for us to start today's hearing. Could I first welcome everybody here to what is the first public hearing in an Inquiry which most of you will know I called on 21 November last year, into the treatment of individuals suspected of people smuggling offenses who say they're children.

The majority of individuals suspected of people smuggling are Indonesian nationals and they're people who have worked on boats bringing asylum seekers to Australia. In many cases these individuals have reported to investigating authorities that they are under the age of 18.

People smuggling is a serious offence in Australia. The offence with which most crew members will be charged is aggravated people smuggling, which involves facilitating the bringing to Australia of more than five asylum seekers. A sentence of 20 years imprisonment can be imposed on a person convicted of aggravated people smuggling. Of greater practical significance to us is the fact that any person convicted as an adult of aggravated people smuggling faces a mandatory sentence of at least five years of imprisonment.

Current Australian policy is that in other than exceptional cases, a child will not be prosecuted for people smuggling offences. Rather they'll be returned to their home, ordinarily Indonesia.

It's this dichotomy between the treatment of adults and the treatment of children that makes the processes by which the age of an individual suspected of people smuggling is assessed, of considerable importance.

During the course of 2011 the commission became increasingly concerned that errors were being made in assessment processes and that this may have led to the prosecution of children for people smuggling offenses and where they were

convicted, to the imprisonment of children in adult correctional facilities, often for long periods of time.

The Inquiry will consider a number of aspects of the treatment of individuals suspected of people smuggling offences who say that they are children. In doing so it will primarily focus on the actions of the Commonwealth agencies responsible for making decisions and whether and where these individuals are detained, for investigating potential charges of people smuggling and for prosecuting alleged offences.

Today's hearing, however, is concerned solely with the use of biological markers for age assessment purposes, in particular, as it's the marker that has been most commonly relied on in criminal proceedings in this court, the use of skeletal maturity of the wrist, as revealed by an X-ray of the left wrist.

I hope also to gain some assistance during today's hearing about the usefulness of other biological markers, such as dental development and bone development in areas other than the wrist and also help if possible, if time allows, concerning the ethical dimensions of using radiography for age assessment purposes.

So if I may turn now to those who so generously agreed to give up their time to assist me by giving evidence this morning. First, may I thank you all, or as the case may be, your organisation, for making a submission to this Inquiry. In this regard I offer special thanks to Professor Cole, who I think is with us. Yes. Who has joined us via video link from Cambridge in the United Kingdom, at what is a very late hour for him. Thank you very much Professor Cole.

I'm also particularly grateful to Dr Low, who has joined us also by video link, in his case from Perth and in his case at an early hour. Thank you very much Dr Low.

Dr Vincent Low: Thank you, Ms Branson.

Catherine Branson: I should note that Dr Low will only be available until 11:45am. So I'll try to deal with the issue of which you are concerned, Dr Low, as early as I can so that you'll be free, without disrupting the hearing, to go at least by 11:45. I'll also do what I can, Professor Cole, to allow you to be excused as soon as possible so that you can get some sleep tonight.

Professor Tim Cole: Thank you.

Catherine Branson: I've asked you all to attend today because I think your assistance in understanding how informative the examination of biological markers can be,

whether undertaken via wrist or dental X-rays or via any other medical procedure, in the assessment of whether a particular individual, a particular Indonesian male individual, is over the age of 18. I'm not concerned with the usefulness of biological markers for any other purpose, despite the fact that there appears to be a great deal of research on that more general question. I need today to concentrate on the particular issue with which the Inquiry is concerned.

As I've mentioned, if time allows I will also seek your assistance in understanding the ethical dimensions of using biological markers in age assessment. I understand that relevant considerations may involve whether and in what circumstances individuals may be ethically exposed to radiation for non-therapeutic purposes, whether and in what circumstances individuals may be ethically exposed to radiation without their informed consent and the related question of what constitutes informed consent. And whether, and in what circumstances, individuals may ethically be asked to undergo an age assessment procedure, which may lack precision and may prejudice those who mature early.

If time allows I'll additionally seek your assistance in formulating a practical recommendation to government, concerning how the question of whether an individual is over the age of 18 years might appropriately be assessed for the purposes of the criminal law, when definitive documentation of his or her age is not available.

It is not my intention to ask any of the witnesses today to take an oath or an affirmation. You are all experts in your respective fields who have offered your assistance to the Commission as it conducts this Inquiry. I take it as a given that you will each assist me to the best of your ability by giving me the benefit of your expert opinions, frankly, and where appropriate, after giving full consideration to any different views expressed by other qualified individuals, whether here or in published papers.

Should today's discussion cause you to reconsider an opinion earlier expressed by you, I will expect you to tell me this. I will also expect you to let me know if you believe that any issue falls outside your area of expertise. It is not my expectation that any of you will see today as an opportunity to advocate for any particular position or to advance the interests of any particular group.

I think it appropriate that I now ask each of you to give your full name, your formal qualifications, the professional position that you currently hold and your

place of employment. If you are speaking on behalf of a learned college, group or society, I'd be grateful if you could identify that college, group or society. I ask you to do this because we are taking a transcript of today's proceedings and that transcript will be placed on the Commission's website and will be available to the public. I think each of you has been advised of that and none of you have any concern about that. Is that correct? Very well.

Then perhaps we'll start with those on the video link. Dr Low, could you please give your name and qualifications?

Dr Vincent Low: Ms Branson, my name is Vincent Low. I'm a medical practitioner. I'm a Consultant Radiologist. At this moment I'm employed by the InSight Clinical Imaging Group, which has practices here in Western Australia.

Catherine Branson: Thank you, Dr Low. Professor Cole?

Professor Tim Cole: My name's Timothy James Cole, I'm a Professor of Medical Statistics at the University College London Institute of Child Health and I've got various post-graduate degrees that I can list and my particular interest is the statistics for growth and development, which I studied for 30 years.

Catherine Branson: Thank you. Dr Hill?

Dr Anthony Hill: Thank you your honour. My name is Anthony John Hill, I'm a practising dentist and I have forensic qualifications. I hold the degree of Bachelor Dental Surgery from New Zealand and hold Diploma of Forensic Odontology from Melbourne University. I am an adjunct lecturer at both Monash and at the University of Melbourne, in dental anatomy. I'm, at present, the President of the Australian Society of Forensic Odontology and I've held the position of Senior Forensic Odontologist for the state of Victoria for the past 20 years. Thank you.

Catherine Branson: Dr Onikul?

Dr Ella Onikul: My name is Ella Onikul. I'm the director of medical imaging at the Children's Hospital at Westmead. I am a Paediatric Radiologist. I am a member of the Royal Australian and New Zealand College of Radiologists.

Catherine Branson: Dr Hofman?

Dr Paul Hofman: Thank you. My name's Associate Professor Paul Hofman. I'm the President of the Australasian Paediatric Endocrine Group. I work at both the Liggins Institute in Auckland and also at Starship Children's Hospital.

Catherine Branson: Thank you. Now the course I propose to follow this morning is to identify, one at a time, the broad issues in which I'm seeking your assistance. Having done so I

will invite those of you who wish to do so to make a short statement on that issue, if I could ask that you keep it to only three or four minutes at the outside. Please feel free to refer to particular parts of your written submissions, or in your case Dr Onikul, the written submission that came from a colleague, I think, from your college, in doing that.

As you know, those submissions are on the Commission's website. Thereafter I may ask you questions and I may invite you to formulate questions for each other, to help me understand where, if at all, there are differences between your respective positions.

Now before we start could I also let everyone know that I am proposing to take a short break during the morning at a time that seems convenient, having regard to our progress, but roughly halfway through the morning. There will be coffee, tea, biscuits and, I think, fruit available, in a room nearby. For those of you who are here with me in Sydney, there are also lavatories close by and the commission staff will be able to assist you in finding those. Because I want to keep the break short, those in Sydney should feel free to bring tea or coffee back with them into this hearing room, but I think out of consideration for our hosts, perhaps not food.

The other thing that might be helpful is that as you will have seen, I propose to address you by your formal titles; you might think it appropriate to address me as Ms Branson.

So let us turn then to the first of the issues on which I'm seeking assistance and I'm going to start with wrist X-rays because I think that will help Dr Low, who needs to depart earlier.

So the first question that I want us to consider - and I know it's not always easy to separate issues, but if we can separate issues I'd like to do that. So the first one I'd like to look at is the usefulness of the Greulich-Pyle atlas generally, for the purpose of assessing chronological maturity. That is, for the purpose of assessing whether somebody's over the age of 18 years.

Now I understand that this may involve the related question of what is the proportion of males who are skeletally mature before the age of 18 years and what are the levels of variation among and between experts, in assessment of the risk X-rays and then identifying the appropriate plate from the G-P atlas. So that's inter-observer and intra-observer errors.

What I'd like to do, if we can, is exclude from this part of our consideration things to do with populations. I'm simply wanting us, for the first part of our

consideration, to assume our subject comes from a population comparable to that used to create the atlas and consider even if they do, are there any difficulties in using the atlas for the purpose of determining whether a male is over or under 18.

Now some of you, I think, might wish to make short statements on this topic and it occurred to me Dr Low that you might be one who might like to make a short statement about this because you have been using the atlas, at recent times, to make assessments of whether or not Indonesian males are over the age of 18 for the purposes of criminal proceedings in Australia.

Dr Vincent Low: Yes, Ms Branson, if I can make a short statement to begin with. I welcome what the Commission is trying to do to find a way through what can be a difficult path. The history of my involvement is I was invited by the Australian Federal Police to provide a more detailed account of what's assessed.

Historically these young gentlemen, when they admit to being a juvenile, receive a wrist X-ray which I understand is the current requirement of our laws. When that happens, Ms Branson, the reporter who takes the X-ray, usually in Darwin, would usually give a one line report which states something like this is a mature hand, this gentleman is over 18 years or this gentleman's over 19 years and that's as far as it goes.

The AFP approached me; it must be approximately two years ago, to look into that matter to try and gain a bit more accuracy, a bit more information, for the court. In that early stage I soon learnt that your colleagues, the gentleman and ladies sitting in the judges seats, had to make a decision based upon a balance of probabilities as to whether the gentleman's over or under 18, based upon all the information available to him or her. Therefore I delve first - and just for a few seconds - I delve first into the validity of the G and P atlas (Greulich and Pyle) and that information, after my research several months, forms the submission which I've given to you.

After I looked at that I then decided that the method remained valid and I agree that it was designed for a population similar to ours, in the Western culture. We won't go into that, we can go into it later if you wish. I found it was suitable for looking at the Indonesian gentlemen and actually gave him a slight benefit of the doubt.

In my history of working with the AFP I've looked at 65 X-rays and those initial X-rays I interpreted I found eight gentlemen were underage and they had already gone back to Indonesia straight away. So in that way there is an early

value and then the rest of them would proceed, in various ways, through the court channels. Some which have come to trial with various results.

So that's the initial basis of which I was kind of involved. As you can tell from my qualifications, I'm not a paediatric radiologist, I'm not a skeletal radiologist. I'm a radiologist who had a history of working with the AFP in terms of forensic matters and I presume they had some respect for what I had to tell them so they asked me about it.

In a way Ms Branson, I have a 25 year history of radiology research and I am actually quite happy that a novice like me in this field was asked to look into the matter, because I went into it with a blank slate. I went into it with a critical view to see whether the method was suitable. Like I said, that was the basis of my submission.

Now as we discussed today I'm sure, as you mentioned a moment ago, there is some difference in opinion regarding (a) the validity of the method - and I can address that first for you, because I'm sure it'll come up in our discussions.

I believe it is valid for a couple of reasons. One is we use it every day in our clinical practice, but (b) I think more importantly my colleagues in the profession are trying very hard to caution us - by us being the people of Australia and our government, about the *blind use* of this technique. I have succeeded in educating the AFP and the DPP that there is a level of uncertainty in the assessment of this person being over or under 18 and I think that was the key message my colleagues are trying to put through to government, that this is not a test which can tell you exactly how old someone is. No test can do that.

Secondly there will be some disagreement in terms of the interpretation of the statistical numbers and we can talk about that later and that will be a useful exercise, I think, for us to discuss.

I welcome the opportunity later to discuss how the G and P technique works, if you need that explanation and I've also taken the trouble to learn about the other technique, namely Tanner-Whitehouse technique, which helps me understand the difference that we see in the statistical numbers.

In summary Mr Branson - and I welcome the Commission's attempt to find a better way to determine age, I suspect it's going to be multifactorial. You, and us the people, are going to find a balance between the costs and the risk of doing it to the young subject, versus the benefit of getting the answer.

I pass it back to you Ms Branson. Thank you.

Catherine Branson: Thank you Dr Low. Before I ask Professor Cole to make a remark could I just ask one question by way of clarification Dr Low? Am I right to understand you to have said that you did not yourself use the G-P atlas for clinical purposes ahead of commencing to provide advice to Australian authorities?

Dr Vincent Low: Oh no Ms Branson. The atlas I use every few days in my current clinical practice. I see the young children - Australian children of course, coming into our practice, referred for various reasons and that atlas is used in clinical practice all the time. That atlas I've known about since I was in radiology school training. It's a basic tool that I've used forever.

Catherine Branson: Great, thank you very much. Professor Cole, would you like to make an opening observation?

Professor Tim Cole: I would. I've prepared something which is rather technical and it covers the gist of everything that I've got in my submission and I'm not sure if you'd want to hear all of that at this stage. It's essentially making the case that the imprecision in the method makes it uninformative for use in age assessment hearings and this applies both to bone age and to dental age. As I say, I'm not sure whether you'd like me to venture into the technicality of it at this stage or whether to try and break it up to some extent?

Catherine Branson: I think perhaps we'll break it up a little. It's just your broad insights on the topic that I'm looking for at this stage, Professor Cole.

Professor Tim Cole: Okay. Well the Greulich-Pyle X-ray gives one information about whether or not somebody is skeletally mature. Once somebody is skeletally mature they stay that way. Therefore talking about how old they are, on the basis of their X-ray, doesn't make sense, because they could be any age from 15 to 100 or whatever. The only age that is useful to talk about is the notional age when their X-ray became mature and this is clearly earlier than their current age, if they've got a mature X-ray now.

Now it's possible statistically to estimate the mean age when that happens and the standard deviation of it. From that one can make statements about the probability of an individual having had a mature X-ray at various ages. My submission is that one can use those probabilities at different ages to make a statement about how useful the X-ray is to answer the question is this individual under 18 or over 18. What turns out is that it is not at all good for that. It doesn't have much discriminatory power at all and in my judgement it shouldn't be used for that reason.

The discussions that are likely to arise in the next hour or so around the probability of somebody aged 18 having a mature X-ray I argue is, to a large extent, irrelevant to the more key question which is answering the question of are they more likely to be under 18 or over 18. They're two separate questions.

I think probably at this stage I'll say no more.

Catherine Branson: Thank you, Professor Cole. If I might just ask you a very elementary question about statistics now before we move on, because I think it might be helpful. I'd like just to take advantage of your expertise to clarify, for my own thinking, the meaning of a statement like, the probability of the subject of this X-ray being less than 18 years of age, on a particular date, is approximately say 61%. Does that actually mean no more than this? That if the subject of the X-ray comes from a population that is comparable with that on which the G-P atlas is based, if we act on the basis that he and all others from the same population who have X-rays that look exactly like his are under the age of 18 years, we will be correct on average in 61 of every 100 cases.

That is, that nothing in the X-ray itself helps us work out whether the particular subject would be one of the 61 or one of the 39 for whom our assumption would be wrong. Is that correct?

Professor Tim Cole: That is true. The individual X-ray tells you nothing about the - you can't make a categorical statement on the basis of an X-ray, you can only make a probabilistic statement that in the population - sorry.

Catherine Branson: That statement about the individual is not actually directly of the individual but if you did it over a large number the probability that you'd be correct a certain percentage of times? Is that right?

Professor Tim Cole: If you drew a person randomly from this population, 61% of the time they would be under 18.

Catherine Branson: Thank you.

Professor Tim Cole: Does that help?

Catherine Branson: It does. Thank you. Dr Hofman, would you like to say anything on this topic?

Dr Paul Hofman: Yes, I would concur with everything Professor Cole said. My main point as an endocrinologist - and we use bone ages daily as part of that process, is to just emphasise the issue of puberty and pubertal variation. That is sex steroids; oestrogen, androgen and growth hormone IGF-1 that influence bone age maturations dramatically during puberty and eventually cause your bones to fuse and your bone age to ultimately become adult.

I think the point that we need to be very clear on is that the age variability in puberty is over five years. So if you take it from girls, where the first sign of puberty is breast development, which starts at the earliest stage of nine years and can be anywhere between nine to 14 years or nine to 13 years and boys with testicular development starting at nine years and going up to 14 years. You're looking at a four to five year range and your bone ages therefore have to accordingly vary by four or five years.

So that's just the normal variation. We of course see children who are earlier and who are older than that with pubertal timing. So just naturally you must have, by definition, a very, very wide range for bone age.

The use for bone age from our perspective is to look at bone age, your physical maturity versus your chronological age. Really it is impossible to interpret a bone age without knowing what the person's age is, because you're comparing biological maturity with their actual maturity and chronological age and trying to work out things like their final height and other issues associated with that.

Catherine Branson: Thank you. Dr Onikul, is there anything you'd like to say now?

Dr Ella Onikul: I'd just like to say that the whole purpose of the Greulich and Pyle atlas is to assess for skeletal age. It is not to work out what the chronological age of the child is. The skeletal age estimation is usually performed in children who are either too short or too tall or have other illnesses. The idea is that they get assessed, they get a bone age. As Dr Low said, we look at the atlas, we work out which is the most appropriate, but there's a standard deviation. The problem is that once the child is skeletally mature it is difficult to say whether what we're looking at is someone who is 15 years old, who is ahead, or someone who is - could be 19 years old. It is *not* a precise science.

I don't think the tables were ever meant to be used to assess a chronological age, it is just a system to try and work out the skeletal maturity, and it's not the same thing.

So I basically agree with what Professor Hofman is saying. I'm no statistician so…

Catherine Branson: We have Professor Cole to…

Dr Ella Onikul: Yes, I know. I use the tables and at the back of the Greulich and Pyle atlas there is standard variation. In the medical area we take two standard deviations to be still within the normal range. Basically they will shape the curve.

Catherine Branson: Dr Hill, this is not really your area, but did you want to say anything now?

Dr Anthony Hill: Well actually - thank you your honour. This actually falls into the area of dentistry in quite a way. It is used - the Greulich and Pyle atlas is used, routinely by most orthodontists. Orthodontists are dentists who straighten teeth. They use the Greulich and Pyle radiographs and they compare wrist X-rays that they have taken of their patients and are looking specifically at the epiphyseal plates of the long bones. At the end of the radius and ulna you have the epiphyseal plate from which this long bone is growing. Dentists - and the Greulich-Pyle atlas was originally used to determine future growth and future development. In other words, is a patient going to grow tall, has their growth finished, or are there some areas there where growth will occur.

That is what we use in dentistry as an indicator of interventionist therapy by orthodontists. In other words, am I going to start your orthodontic treatment now, because I know that there's going to be future growth in your head and neck region and in your jaws, or has your complete growth finished.

The atlas was never, ever designed, nor was the technology there, to base the hand-wrist X-ray on a chronological age assessment. It was never used for that. Therefore I think that in the use of the Greulich-Pyle as the sole arbiter of the chronological age of an individual – to use that as the primary source of information is technologically that's being applied to a totally wrong format. It was never designed to do that.

Catherine Branson: Thank you. Now we all have a…

Professor Tim Cole: Could I make a point?

Catherine Branson: Yes, Professor Cole.

Professor Tim Cole: Sorry, could I make a point. The important thing about the Greulich-Pyle atlas is to draw a distinction between the plates for ages up to 18 and the plate for age 19. Because the plate for age 19 is the mature X-ray and the way that it's presented in the atlas it looks as if it is for 19 year old individuals and this is not the case, because it's the mature X-ray and it continues to apply after 19 years, all the way through adulthood. This is importantly different from all the other plates which correspond to a particular age, plus or minus a fairly narrow variation.

That is the key point that people attach much too much attention to this age 19 X-ray and argue that it corresponds to chronological age 19 and that is categorically not the case.

So it's important to see that the age 19 X-ray is different from all the others.

Catherine Branson: Thank you. We all have folders, I think, with us, with pages numbered on the bottom right hand side. Could I invite everyone to turn to the submission of Dr Low and in particular at page 55?

We'll see at the bottom of that page some calculations of probability, which I think Dr Low has prepared himself, about the probabilities that a person showing skeletal maturity is of a corresponding age or less. Dr Low, am I correct in thinking that you calculated these probabilities?

Dr Vincent Low: I did myself, yes. Yes, I did.

Catherine Branson: We'll see that the 18 years of age one gives a percentage probability of being less than the age of 18 or 21.79%. Before we go on Dr Low, so you adhere to that calculation, having regard to the others…

Dr Vincent Low: Yes, I do.

Catherine Branson: …that I think you've had an opportunity to read?

Dr Vincent Low: Yes, I do.

Catherine Branson: Professor Cole, it occurred to me that you may wish to ask some questions of Dr Low about this calculation.

Professor Tim Cole: Wel,l I think I know the answers. I've seen several of Dr Low's reports, all of which contain this particular table and I understand how he calculated it. It's on the basis of the mean age for a mature X-ray being 19 years and the standard deviation being 15.4 months. These are both contained on his page 55. This relates directly to the point I was making just a moment ago, that it's inappropriate to attach a mean age to a mature X-ray.

A mature X-ray does not have a mean age. It has an age from when it first appeared, right the way through until the individual dies. So the idea of saying this is a mature X-ray, this person's mean age is so and so makes no sense. The only age that you can usefully focus on in an individual whose X-ray is mature is the age when it first matured. That is not the age of 19 that comes from the Greulich-Pyle X-ray; it's at an earlier age, which I've calculated separately.

So I argue quite firmly that 19 years, which is the basis for Dr Low's table, is inappropriate and he should be using an earlier age. The age that I come up with is 17.6 years. If you use that you come up with a probability of not 22% but 61%.

Catherine Branson: Thank you. Dr Low, having heard what Professor Cole says about this, and I think you've known this for some time, because I think you've had access to expert reports prepared by Professor Cole, what do you say about Professor Cole's criticism of your methodology?

Dr Vincent Low: When I first learned Mr Cole's figure of 61% and average maturation age of below 18, I was reasonably quite perturbed. Being a researcher I was thinking what's wrong with the Greulich and Pyle atlas that it seems to be far off. Now going back to Greulich and Pyle, and Dr Onikul will probably agree with me I hope, if one looks at the 18 year plate for males, it's actually defined as being a not yet mature bone age. Which means according to Greulich and Pyle, the 18 year old is not mature. Which means maturity occurs at some point after 18 years.

Now I agree that your hand, Ms Branson, and my hand would look like our hand almost the day that we achieved maturity and that's quite true, it stays stable. But while we are looking at the point, as Professor Cole says, at which maturity occurs. It occurs somewhere above 18 years, as defined by Greulich and Pyle.

So I was very perturbed that Professor Cole's average maturation age was below 18. That did not make sense to me at all as a scientist. I am familiar with Greulich and Pyle and may I presume Ms Branson that you've looked at the atlas yourself and seen the various plates?

Catherine Branson: I have it on the table here with me, Dr Low, and I've looked at it very carefully.

Dr Vincent Low: Okay. So I then explored Tanner and Whitehouse, which is the basis by which Professor Cole does his work and it's a very respectful and very authoritative piece of work, which differs from Greulich and Pyle. Greulich and Pyle, as you know, is a set of plates where when the subject comes to our clinic and has an X-ray we compare that person's X-ray with the plates on the X-ray, plus with the descriptions on the side and make an assessment as to the skeletal age and we all agree with that.

Tanner and Whitehouse is still officially looking at the same thing, looking at the level of maturation of those 29 bones in the hand but in a different way. It provides a score for each bone on nine different categories from A to I and they're scored and put together to provide a final score. That's a very good method when you are dealing with that growth spurt time when each bone is doing a lot of changes and gives you a lot more detail in the earlier years. In fact you will find in the readings, other researchers, like Smith and Brown, Ian

Schmelling, all says that Tanner and Whitehouse is excellent for the under 16 but once it goes beyond that it falls by the wayside.

I can see why. I soon discovered the reason why Professor Cole and I have a difference in opinion as to the age of maturation. You see, the final stage - you probably are aware that the last bone to mature in the wrist area is that radius, that big bone on the thumb side. At the age of about 17 all the other bones have achieved maturation except for that distal radius. The last stage of maturation is listed by Tanner and Whitehouse as category or stage I. If I can read from the Tanner and Whitehouse book and for Dr Onikul and Professor Cole correct me if I'm wrong. Stage I is described as ‘fusion of the epiphysis, (which is the bit at the end), and the metaphysis (which is the main bone), has begun.’

That's key. Stage I is beginning of fusion. A line may still be visible, which is that black line, partly composed of black areas, where cartilage remains and partly composed of white areas where fusion is proceeding or the line may have disappeared. Now again I will, through the Commission, ask Professor Cole and Dr Onikul to correct me if I'm wrong, but I read that as saying that stage I is a process. It's a time period that involves the fusion of that last radius bone epiphysis.

Now it doesn't state anywhere in either Tanner and Whitehouse or state anywhere in Greulich and Pyle, but being a practising radiologist that sees it every day that process takes approximately two years. Now if Tanner and Whitehouse method gives a score of the highest calibre to stage I, which is the last stage it measures, then the higher score occurs when stage I begins. Greulich and Pyle, on plate 19, is talking about where stage I ends. We are talking about two different themes in defining bone maturation, which differ by about two years.

I would ask Dr Onikul if - I mean she would know better being a paediatric radiologist, to correct me if I'm wrong. So based on that, I then understood why Professor Cole's age of maturation was below 18, because by Tanner and Whitehouse he's measuring the beginning of that final stage of maturation, which sensibly occurs two years before what Greulich and Pyle defined. So if he defines maturation age as about 17 years, then it would make sense that Greulich and Pyle would define maturation as about 19 years and that makes sense.

If we get past that argument, which is a constant argument for you Ms Branson, then we actually agree with each other and that holds validity to my idea that the approximate probability of a gentleman showing a mature hand, had that occurred before 18 in about 22% and after 18 in about 78%.

So I guess the first thing that I may ask the Commission is, may I ask Dr Onikul if what I say makes sense or if I'm incorrect in some way, if I may?

Catherine Branson: I will ask Dr Onikul in just a moment but I think I might first ask Professor Cole if he'd care to respond to what Dr Low has just said?

Professor Tim Cole: Well, put very simply, I disagree with what Dr Low has said. I should emphasise, I'm not a paediatric radiologist, but I have colleagues who are. This similar point having being put to me, I spoke to one of the authors of the TW3 document, Professor Noel Cameron, and he pointed out to me that the rubric which Dr Low has just read out for the stage I, for the distal radius, changed from TW2 to TW3.

The wording for TW2 I can't quote it, but it made it very clear that it was the final stage of the radius; it was not part of the process. I asked him, why did the wording change in TW3 and he said, well very often you don't actually see the line on the distal radius disappear. It doesn't actually disappear at all. So to argue that the process is completed, will in a good proportion of cases be inaccurate.

Now, I am pleased for the paediatric radiologist there to respond to that in due course. But Dr Low is still insisting that age 19 is the age of a mature X-ray and it categorically is not. That is not what the people who produced the Greulich-Pyle atlas intended. They gave it as age 19 because they had given a whole series of plates at ages 14, 15, 16, 17 and 18 and they wanted one to indicate the final stage, so they called it 19. But it isn't 19, it's adult. In any case, the age that I'm talking about is not the age when you see a mature X-ray, it's the age when a mature X-ray was first attained and it's earlier than that.

Now, he could reasonably argue that it's after 18, because the age 18 plate was not mature, but it's worth reading in detail what Greulich and Pyle say about how they chose their X-ray and it isn't necessarily the average for the age group. They choose one which makes - for reasons which I don't understand, but they chose an X-ray which is usually, but not always, the typical one for the age group. In any case, what we're disagreeing about is 17.6 and a little bit over 18. So I don't see a major discrepancy there.

Catherine Branson: Thank you. Dr Onikul, could you perhaps help preside on I think the two points?

Dr Ella Onikul: We don't use the TW2 or TW3 method because it's a very complex method. So I don't have great experience in that. I mean I read the studies, but it would take quite a long time in a busy paediatric hospital. As I say, the reason why we assess the x-rays is not to determine the chronological age. All we're looking for is how *skeletally mature* the child is. To say that skeletal maturity is reached at the age of 19 is incorrect. The radiograph that Greulich and Pyle has of the 19 year old, as they say is 19, it could be someone who's 40, because the radiograph would be the same.

Catherine Branson: You heard Professor Cole indicate the basis on which - you heard and in part read the basis on which Professor Cole calculates that the average age of attaining a mature X-ray in a male is 17.6 years. Are you able to comment on that in anyway?

Dr Ella Onikul: I think his methods seem more valid and more correct, just by an experience of looking at radiographs and kids ages, certainly some reach maturity at that age, some younger and some older. It's not precise.

Catherine Branson: So are you able to express a view between the two competing opinions that I think I now have, is that on the one hand Dr Low is saying, I think, that the probability that a person showing skeletal maturity at less than 18 is only 21.79%, whereas Professor Cole is saying that the probability of attaining a mature X-ray before the age of 18 is 61%. Are you able to assist me in which of those views appears, from your experience and expertise, to be more accurate?

Dr Ella Onikul: I agree with Professor Cole's view.

Catherine Branson: Yes, Dr Hofman?

Dr Paul Hofman: Can I just point out that from an experiential perspective, rather than a statistical perspective, I would deal with somewhere between five to 10 patients who are aged 19 to 20 with bone ages less than 14 every year. So the 0% is obviously wrong. These are people who go through puberty very late and my adult colleagues would see even more than that.

So I don't accept the table in its current format. I do wonder whether in part it's because they've used standard deviation scores. Standard deviation assumes the normal distribution. There is no way that a bone age assessment has a normal distribution. You're going to have a very long tail at the young end and maybe Professor Cole would like to speak to that. Because I think calculating, using, SD in a population which is not normally distributed, can be problematic.

Catherine Branson: In your view the distribution of bone age is not normal?

Dr Paul Hofman: It's not. There's certainly a marked tail on the young side.

Catherine Branson: Before we go on, perhaps Professor Cole do you want to comment on that?

Professor Tim Cole: Well this is the fundamental question. How can we get a handle on the age of attainment of a mature X-ray. That's why I went to TW3, because it had a table which gave ages of attainment. There's nothing about that in Greulich and Pyle because Greulich and Pyle were not remotely interested in mature X-rays as needs emphasising. They really were not interested in them.

The table I used, I'm happy to acknowledge that it's rather limited and it would be far, far better to have an original source of data on stages of hand-wrist X-rays that could be analysed and come up with a rather more formal answer to the question. In that process it would be possible to test Dr Hofman's suggestion that there is a long tail to the left. Certainly I don't have the data available to be able to comment on that.

Catherine Branson: Thank you. Dr Hill, can you assist us in this part of our discussion?

Dr Anthony Hill: Well, my input into this is that I questioned the use of the Greulich-Pyle rate atlas to assess the chronological age of any person. I do not believe that the Greulich-Pyle atlas was ever designed for an assessment of chronological age. It was put together primarily to look at the welfare and wellbeing of an individual and to look at future growth in their skeletal elements. *Not* to have anything to do with assessing chronological age.

So I question why are we still persisting with an atlas, which was not designed for this purpose at all?

Dr Ella Onikul: That's exactly right.

Catherine Branson: Thank you very much. Before I move on, as I'm thinking of doing, from this particular issue, which I think we've explored fairly well. Dr Low I think I should give you a final opportunity to make any observations about the procedure that you have been using and your reliance on the atlas. Would you like to take that opportunity?

Dr Vincent Low: Thank you, Ms Branson. Firstly I didn't choose to do hand X-rays on these young gentlemen. It was a decision made by our government a long time ago. Let us, if I may, review just for our Commission, the process.

These gentlemen have the X-ray as per law well before I become involved. The AFP then has asked me to submit my opinion, which is the document I've just

created in the tables given. The technique has a value, because as I mentioned, if that initial X-ray finds an immature hand, those subjects will be accepted by the AFP as being immature and therefore probably less than 18 and as per the law requires, deported back to Indonesia straight away. So it has an initial value. Then of course you have to argue the ethics of the small radiation dose to achieve that result.

Now I actually agree with all our colleagues gathered around before us about the invalidity of the Greulich and Pyle to give us chronological age. That's I think, the key issue that all our bodies, including myself, wishes our government and the Commission to understand. There's no way this test - I think you've already the understanding of that Ms Branson. There's no way that this X-ray can tell us that this gentleman is say aged 17 years, 11 months and 29 days, versus 18 years, 1 month and 1 day. It cannot do that.

What I then was given the task, from understanding working with the crown and with the police, was that the courts then had some idea of how much value, how much relevance that X-ray had. The initial X-ray report written by the first radiologist reads the X-ray would be a one-liner which says mature hand equals age over 18, or age over 19 depending on who's reading it.

Now if a judge sat in court and had that report, their interpretation is only one. The interpretation only is: this person is over 18. I'm actually introducing the level of doubts, the level of benefit of the doubt that we should give to the subject as to how likely it is he could be under 18.

It is quite true what Dr Hofman says, about the variation and the tail of the statistics and I actually am aware of that, but it's not material that you can glean from Greulich and Pyle. The Greulich and Pyle atlas provided me with a standard deviation of over 15 months, which means a 2 SD of 30 months, which means a spread of age of five years of a person achieving maturity. That is one possible submission I can give to the court as to the interpretation. Or I can give a statistical figure which, with its limitations still tells the courts that this is not an exact science and that was my mission.

The figures may vary between myself and Dr Cole, but I think we actually agree in fundamentally the way that the amount of accuracy is not there. It's just how inaccurate we're talking about is where we differ.

So in a way, a small price to pay allows a substantial number of subjects who claim to be juveniles to actually have their case not even to have to go to court.

They can actually be dispatched back to Indonesia by deportation and then the rest will go on.

I agree, the test is not exact. The test has fallacies, the test has problems. I've been liberal in trying to find an answer to give to court to understand how reliable, unreliable it is and that was my mission.

[Technical difficulty]

[Aside discussion]

Catherine Branson: There was just one final question I was going to raise before we move on. Is it possible that we could reach agreement, and please let me know if it's not, that whatever we think about the value of wrist X-rays to determine whether somebody is over the age of 18, they are useful if they're immature to establish that someone is under the age of 18. That's your position I think isn't it, Dr Low, that they are useful for finding that someone's not 18?

Dr Vincent Low: Yes. You can argue that if a hand comes back as being immature the person actually could be over 18, but I understand we should use the principle of the benefit of the doubt and in that way the subject would get the benefit and they'd be considered as being under 18. So I think that is a valid use of it and it's borne true in my experience.

Catherine Branson: All right. Professor Cole do you have a view about that?

Professor Tim Cole: Well, I rather disagree because what it means is that people who are skeletally immature are treated beneficially and people who are skeletally mature early are penalised. They will consistently be rated as being over 18 when they're not. That is one of the inequities of any sort of developmental age assessment, be it bone age or dental age. People who happen to be developmentally advanced are going to be more likely to be rated as over 18.

Catherine Branson: I was hypothesising this, Professor Cole, that a recommendation might be formulated in terms of allowing or recommending that the court receives wrist X-rays that are immature for the purpose of establishing youth, but they not be entitled to receive them as proof of maturity.

Professor Tim Cole: Well that would be clearly less inequitable, yes. I would make one other point, that a mature X-ray can be informative in a situation where the person who says they're a child says how old they are. If they say they're below a certain age, which looks to me like age 15 or 14, the chances of them having a mature X-ray are on the basis of the European references that we rely on, extremely

low. On that basis one might say that a mature X-ray is inconsistent with the age that you're claiming. But I emphasis this is very low.

Catherine Branson: It would be no more credible. Yes. Whilst it may prove that it's unlikely that they are the age they say, it wouldn't be probative of their actual age would it?

Professor Tim Cole: That's quite true, and they could well be still under 18 if they're older than what they say.

Catherine Branson: Yes, thank you. Dr Hofman is there anything you want to say before we close this, particularly on whether X-rays might be useful for establishing youth but ought not to be relied on to establish maturity?

Dr Paul Hofman: I have some of the same concerns that Professor Cole had. I think the approach that you suggest would be a reasonable one. There's no question that there a substantial number - well it's a minority but of the practice I see, a substantial number of people who are over 18, who have X-rays which are less than that. So I think a younger skeletal age on a bone age does not actually preclude the fact that you're 18 by any stretch of the imagination.

Catherine Branson: No, okay. Thank you. Dr Onikul.

Dr Ella Onikul: Yes, well I agree with that. It's not absolutely definite but it's less likely if the bone age is much less than 18, less likely that the person is mature.

Dr Paul Hofman: I would just like say that we have been forced into a situation where we've had to use Greulich and Pyle. No recrimination should ever be brought against Dr Low or anything and I can feel he's concerned about this. We have to work [inaudible] and part of the Commission here of course is to look at alternative methods that we could introduce in here.

I think that the gist of what I'm hearing here is that this has got to be a multifactorial approach. We cannot rely upon a two dimensional radiograph, whether it be of teeth or whether it be of hand/wrist, to actually assist the court. We can assist them to an extent, but we must be looking at multifactorial issues that will further assist the court.

Catherine Branson: Thank you. We've been talking to date about limitations in relying for the purpose of assessing maturity on the Greulich-Pyle atlas in general terms. I'd now like to explore, if I could, the usefulness of using the Greulich-Pyle atlas for the purpose of assessing the chronological maturity, in the early 21st Century, of members of a particular population of Indonesian males, namely, as it seems, socioeconomically disadvantaged Indonesian males from coastal villages,

selected to crew boats used to carry asylum seekers and who say that they are children. That is a quite distinct population of men, or young people.

Now I understand that this question may involve questions concerning ethnic and socioeconomic differences in rates of maturation and other potential influences on the composition of the population of concern, as well as the possibility of general changes in maturation rates since the time when the atlas was formulated.

So if we could follow the procedure I did before. Could I ask you first Dr Low if there's anything generally you want to say about this?

Dr Vincent Low: Yes, thank you, Ms Branson. The submission I gave to you actually was the same questions I asked myself two years ago when the AFP approached me. It goes through that step by step. The first question I asked was, this book was written 70 years ago now, is it still applicable today? I did not put all the references down but two reasons why it's still applicable today, one is we colleagues still use it today, is probably the most powerful reason. Secondly is there are counterpart atlases written - composed by other authorities, probably the most famous is Gilsanz in California, who found the same levels of maturation of the Californian children of the 21st Century as in Greulich and Pyle.

So question number one, is the work of the early 20th Century still applicable for the same population today, the answer's yes. The second question is a common sense question. Is 70 years enough to cause a change in the genome to cause a change and a result in the human body. The answer is no.

Next question is probably the most difficult to answer, namely does the ethnicity cause a significant change. Now surely it will because we're all different, even just looking around this video link right now. But from the legal point of view - although I'm not a lawyer I've worked forensically across the world. The key issue is, is there a factor which is a disadvantage to the subject.

So now, in looking at hand maturation, if something makes the hand mature earlier, then the bone age X-ray would overestimate their age, which is a disadvantage to the subject. If something makes the hand mature later, then the X-ray would under interpret the age and be a benefit, in terms of legal terms, to the subject. So that's the key thing, is it advantage or does it disadvantage the subject.

I think Dr Hofman hopefully will agree with me, as would Dr Onikul. The key factor that's been found in work is that - besides of course the endocrine

conditions, which are quite powerful. In terms of the general population, assuming they're healthy people, the socioeconomic status has the greatest impact far more than the ethnicity. A poorer socioeconomic status results in a delay in maturation and therefore is a legal advantage to the subject when looking at their hand X-ray, which means that whatever I might say the gentleman's age is, I'm actually making a mistake making him younger than he really is. So he is at a legal advantage.

So coming back to socioeconomic status, the socioeconomic status of these gentlemen coming from the eastern Islands of Indonesia would be poorer than the socioeconomic status of a Western population. So the X-ray would be an advantage to them.

Finally, ethnicity. In the ideal scientific world we would have done a Greulich and Pyle type study on exactly the same population and derive exactly the same kinds of tables or graphs or pictorials to assess, but we don't have that. There've been probably 160 articles talking about various aspects across the world and there are many that say ethnicity increases it, there's many that says ethnicity decreases maturation. So it's about an even keel.

Seeking articles which I then have mentioned in terms of the South-East Asian population, there was one from Thailand and one from Malaysia which found a satisfactory agreement with the atlas in terms of assessing the age of those studied populations. Not indicated in that article I've given you, I more recently found, in the dental literature I believe it was, article by a gentleman named Soegiharto in Jakarta, looking more at dental maturation, as well as hand X-ray maturation and that article found that comparing white boys and the ethnic boys, the white boys matured approximately a year ahead of the ethnic boys. Which means, once again, the ethnicity actually caused a delay in maturation and therefore is a legal advantage to the subject.

So those are the results of what I've explored and found, which summarises that whatever the G and P atlas determines from the world population, the population of interest, namely the young men from eastern Indonesian islands, actually are advantaged legally by using the atlas. They are actually less mature than the white reference population.

Catherine Branson: Thank you, Dr Low. Just for clarity, did any of your studies of ethnic difference concern people of Indonesian ethnicity?

Dr Vincent Low: Yes, the Soegiharto one, which I haven't included because I discovered it after I wrote that submission, was written about 2008 and it appears in the dental

literature. I can get the reference to you and to your panel members later, when I get to my office if you like.

Catherine Branson: Thank you, Dr Low. I appreciate that.

Dr Vincent Low: I think that will be useful because - yes, I'll do that for you.

Catherine Branson: Thank you. Dr Hofman, do you have any observations to make up there?

Dr Paul Hofman: Thank you. I haven't seen that article. I did a literature review a while ago, so I'd like to see it Dr Low, it sounds great. But I do have some issues. The first is you're completely correct that in the limited literature out there, ethnicity does not seem to play a huge role as far as I can see. There are some differences but not a huge role that you can see between Turkish, between African-American compared to Hispanic, compared to European. That said, we know that obesity advances bone age quite dramatically. So societies where there's a lot of obesity will find bone ages advanced one or two years for a given chronological age. That is not usually an issue I think in Indonesian societies.

I guess the issue that I really have - and this is a calculated speculation. It's that if you were choosing sailors to smuggle children, or to smuggle people across, are you going to choose a 16 year old who looks like an 18 year old, or are you going to choose a 16 year old who looks like a 12 year old? I contend that you probably choose people who are more mature, even though they were younger, so that you would have that intellectually and emotionally, you'd have a younger person who could do more work.

So I'm not completely convinced with the argument that you're biasing in favour of these potential children. I have a suspicion, and it's only speculation, that they'll more likely choose people who looked more mature and who had more advanced puberty and that group who had advanced puberty and so you're going to get a selection bias. That's my suspicion but I obviously can't prove that.

Catherine Branson: Yes, that was a concern I had Dr Hofman, that you might have a selection bias here in the circumstances with which we are concerned about. I also wondered whether statistically the fact that they say they're children doesn't itself distort the population. You would expect of two groups of Indonesian young people, one that was selected randomly and one that was selected from a group who said they were children, to be statistically more likely to be children. Is that a fair assumption?

Dr Paul Hofman: [Unclear]…It is probably very fair.

Catherine Branson: Dr Onikul is there anything you can contribute to this topic?

Dr Ella Onikul: I agree. I mean from reading the literature there's really not that much variation. Some races tend to mature a little bit quicker around puberty but then it catches up. I mean as Professor Hofman says if you're obese, yes.

I've got a study here that basically said that particularly in black and Hispanic adolescent girls and Asian and Hispanic adolescent boys, bone age may exceed chronological age by nine months to 11 months. I mean there's all been studies done, but there's not a great basic difference.

Catherine Branson: Thank you. Dr Hill, it occurs to me because of time you might prefer to speak about this topic more when we're talking about dental development. Yes, thank you. Professor Cole, is there something that you'd now like to say on this topic?

Professor Tim Cole: I think broadly I agree with what's been said. I think the important point to make is that although there are - it is known that socioeconomic status, ethnic group and nutritional status may all impact on the bone age, it's very hard to actually come up with a number that one can use to make any sort of adjustment. All one can do really is wave ones hand in the air and say whatever certainty we had based on a European population, that certainty decreased substantially when we moved to talking about an Indonesian fisherman population.

If I could just make one follow-up comment? I did, if possible want to make a separate statistical point, which in a sense makes this discussion slightly less relevant. I'm not sure if you felt able at some point to get on to that.

Catherine Branson: Please tell us what you're thinking of Professor Cole?

Professor Tim Cole: I think everybody has agreed bone age assessment is extremely variable. The difficulty is how you actually turn that into a number to say that it is too variable to be used. In my submission I show how you can actually look at that question - I have a graph on page 31, that's in section two of the submission.

Catherine Branson: Just pause a moment while we all turn that up. Yes, thank you Professor Cole.

Professor Tim Cole: We're going back to talk about the probability of an individual's X-ray having become mature before aged 18. The graph shows a curve which is based on the mean and standard deviation which I previously have quoted at 17.6 years for the mean and a standard deviation of 16.5 months. These I calculated from the TW3 atlas. Using those you can draw this graph that's shown on page 31.

So at age 18 you can read off 61%. Now in the case of an age assessment hearing this graph is absolutely fundamental because it tells you how useful the X-ray is for judging somebody's likely age. We know that the individual in the

hearing will have a mature X-ray, we're fairly sure about that. But the question is, are they over 18 or are they under 18? This graph shows the probability of them having achieved a mature X-ray at different ages. So for example, at age 17 you can read off, it's about a third, 33% or so at age 17. At age 19 it's a bit higher at 84%. The differences between those probabilities indicate how useful the X-ray is for making the judgement are they under 18 or over 18.

Now if we calculate the ratio of those two, that's 84% over 33%, we get the answer 2.5. Now that's called a likelihood ratio. I'm sorry to introduce a technical term here, but that's called a likelihood ratio and it means we can say that in somebody with a mature X-ray they're 2.5 times more likely to be aged 19 than aged 17. So this likelihood ratio of 2.5 tells us how informative the X-ray is.

So what does a likelihood ratio of 2.5 mean? Well the answer is it's extremely low. It's generally accepted that a likelihood ratio of less than five to 10 is uninformative. So this is a way of stating that the X-ray doesn't allow us to separate the groups of young men who are under 18 from over 18. One can apply a similar argument to dental age, which I can perhaps talk to later on.

Now that in a sense is all a bit of a preamble because this is a graph based on the TW3 population but we can think of it as being based on the Indonesian fisherman population. That will move this graph to the left or to the right a little, but it won't alter the shape of it. It won't alter the likelihood ratio. So although we may be arguing as to whether it's 61% or 30% or 90% for an Indonesian fisherman, either way, the mature X-ray is not informative for deciding whether they're under or over 18 because of this likelihood ratio. The likelihood ratio is low because the standard deviation is large. I'm sorry, that's rather technical but it is pertinent to what's being discussed.

Catherine Branson: Yes, thank you, Professor Cole, it is. Before we move on, Dr Low do you wish to say anything about it?

Dr Vincent Low: I have to come back just briefly, and it's something that you'll probably have to do off discussion. In our earlier discussion Professor Cole described my quotation from Tanner and Whitehouse as being - Tanner-Whitehouse 2, I've just checked my notes. The quotation I gave regarding the final fusion stage is from Tanner-Whitehouse 3. So the Tanner and Whitehouse 3 does talk about an event which commences with the fusion of the bones and ends with the completion of the fusion, which as I mentioned before is about a two year period, which again makes sense that our data actually agrees.

So Professor Cole is quite right. There is about a 61% chance that the young men's hands radius begins to fuse before 18, but we're not measuring the same thing. I do understand what he means by the probability curves and the relative probabilities and that makes sense and I agree. But we're measuring different things.

Catherine Branson: Right, thank you very much. I think it a fair assessment from what we've heard from everyone today, that the problem with wrist X-rays, assuming there to be one, is not one that can be readily addressed. We don't have alternate data sets available to us, technology to read the X-rays or even the atlas is not likely to improve it. Adding greater number of specialists to read the X-rays and choose the plates is not likely to improve the process. Is that a fair reading? You were seen to be agreeing Dr Low?

Dr Vincent Low: I agree. All radiologists have used it for 60, 70 years. I myself have used it for 25 years. As Dr Onikul said, it's a nice, simple method for us to very quickly in a busy practice - and as Dr Hofman says, give us a skeletal age and that's its purpose.

I think yes, you're quite right. Changing technology - more radiologists would not change their interpretation.

Catherine Branson: Okay. So is everybody agreed with that? Yes, very well. Thank you. I'm conscious of the time. Professor Cole, I think I'm rather in your hands. We could go on now straight to dental X-rays and try and deal with the statistical aspects of them now or we could take a short break. I'm anxious to get you free as soon as we can. What would you prefer to do?

Professor Tim Cole: Should we move to dental X-rays?

Catherine Branson: All right. Is everyone else happy to go straight on and we'll take a break in maybe half an hour or so? All right. Well then let's turn to dental X-rays. Before we do, Dr Low I think you have no special interest in dental X-rays, is that right?

Dr Vincent Low: No, afraid not. But I can I say, I'm very pleased for the Commission to consider it because I think it's a good idea.

Catherine Branson: Good, thank you. In view of the issues that I raised when we outlined, of the things we might be looking at today, which once we move from dental X-rays will include ethical dimensions of using radiography and the possible suggestions of what would be a useful mechanism for age assessment. Is there anything that you want to contribute on those points? Because if you could do it very quickly we would be able to let you go, I think.

Dr Vincent Low: Well, thank you Ms Branson. I think I can. The big fear, rightly and wrongly, is the radiation dose. We, in the profession, Dr Onikul and myself, we usually relate the radiation dose, not at the high level, like in an A-bomb situation, but we usually relate it back to background radiation, which you will understand. As we live where we sit right now we are constantly bombarded with radiation. We receive about 2 millisieverts every year. Am I right Dr Onikul, is that about the right figure?

Dr Ella Onikul: Yes, about. I don't have the table.

Dr Vincent Low: No, that's okay, it's around that figure but it gives the ballpark idea. Now we often, in the practice, then relate the amount of radiation we deliver into performing our various tests to the amount of background radiation and that gives us a good idea.

A hand X-ray is one of the smallest dose x-rays we can possibly do because - and the smallest risk to the subject because of the peripheral nature. The small size of the hand, the small area to be X-rayed. The dose that we deliver is approximately 0.0001 microsieverts, not millisieverts. That equates to approximately three hours of background radiation.

So sitting here for three hours I will have received the same amount of radiation from the background as I would having an X-ray taken of the hand. A dental X-ray, an OPG which Dr Hill will know what it is, I believe takes approximately three days of background radiation. So you're talking about that difference in radiation dose. There are alternative X-rays that can be done, like X-rays of the pelvis, X-rays of the clavicle, and you're talking, in those areas, an even greater dose than the dental X-ray.

Finally there's proposals in the research to do CT scans, which gives even more exact measurements and CT scans deliver in the order of months of background radiation. I think those kinds of figures then give a lay person, with all respect to you Ms Branson, an idea of how much radiation is delivered.

We usually consider a few hours of radiation as being negligible, a few days as still being negligible. The doses delivered, in terms of body X-rays and in terms of body CTs, then starts to be of concerned that if delivered inappropriately over time you could create risk factors to the subject.

So in terms of - I mean even to go beyond that, we hate to deliver X-rays you don't have to in any situation, even for the hand. That's something we as a society had to decide in terms of the value versus the benefit of doing this thing. So a hand X-ray would be a dose which is so [unclear] small that if you accept

a small radiation dose that would be acceptable. A dental X-ray is similarly - it's a larger dose, but it's still a small enough dose that we as a society should be able to accept as being negligible in effect of a subject.

Once it gets beyond that, into body X-rays and certainly body scans, then one has to be very careful that we're now heading towards a low dose rather than a negligible dose, which one should be concerned and it has to be of definite value to us as a society, in what we're talking about today, or to the subject, in either the subject having the X-ray, that we consider it to be done.

I hope that makes sense to you.

Catherine Branson: It does. Thank you very much Dr Low. If you'd like to leave now you are free to go. I thank you very much for your assistance this morning. You're of course welcome to stay on.

Dr Vincent Low: I would like to listen if I may?

Catherine Branson: You're welcome to stay and listen as long as you like. If there's further contributions you want to make well of course I'm happy to receive them, but I know you need to get away and please feel free to let the court officer there know whenever it is that you want to leave.

Dr Vincent Low: Thank you, Ms Branson.

Catherine Branson: Thank you, Dr Low. Could we then turn to considering dental X-rays and perhaps adopting the same model as we did before, consider first the use of dental X-rays generally, for the purpose of assessing chronological maturity, whether someone's over the age of 18 years, and not worry so much first about the specific population of concern here. I understand that this might involve asking related questions of how informative are the dental X-rays and what are the levels of variation among and between experts in assessing dental X-rays?

Dr Hill, you might be a good person to lead off on this.

Dr Anthony Hill: Thank you very much, Ms Branson. Thank you for giving me the opportunity to address the Commission on this very critical issue of age assessment and thank you for giving me the opportunity of submitting on behalf of the Australian Society of Forensic Odontology.

The basis for my age assessment submission is primarily founded on the premise that the human dentition, from birth to adolescent years, developed in an ordered, predictable and age related fashion. The primary teeth, our deciduous teeth, our baby teeth, they erupt in a projectable sequence and this

is completed around about the age of three years. So that does not actually affect what we're talking about here.

But the replacement of these deciduous baby teeth, with our permanent dentition, begins at the age of six and signals the beginning of the loss of all deciduous teeth and the replacements with their permanent successors. This occurs, again, in a predictable, sequential sequence and it is chronologically age related. In other words, we lose our lower canines at age 13; we gain our lower anterior teeth at aged six. These are predictable, these are sequentially done and the research and the body of evidence behind this, which has gone on for decades, has shown us that this can be predicted.

Of course, many, many, many interventionist surgical procedures are related to the age at which a tooth will appear, the age at which a tooth does not appear and will be determined by this age predictability as we lose teeth and they are replaced by our permanent successors. This is called a mixed dentition phase and we actually - this phase is completed by the age of 15. The only tooth after the age of 15 which is still developing, which is still maturing, which is still calcifying and still erupting is the lower wisdom teeth, upper wisdom teeth, our four wisdom teeth. This is the tooth that we concentrate on and have been asked to concentrate on when we're doing our age assessments for individuals of unknown age.

If you look at the deciduous teeth and a period of mixed dentition when baby teeth are being lost and replaced by permanent successors - as I say, this is generally complete at around about the age of 15. If there is any age dispute it is a simple question of a dentist counting the number of teeth within the oral cavity and if there are any deciduous teeth, baby teeth, which are present within this mouth, this person is a child. There's no disputing this. If you have deciduous teeth within your mouth, baby teeth that are yet to be lost, then you are under the age of 15, you are a child.

The process of determining this is a simple examination by a trained odontologist, a trained dentist.

Catherine Branson: If I could ask you to concentrate on the 18 year one side or other as that aspect, I think it would be helpful.

Dr Anthony Hill: I'll do that, yes. Beyond the age of 15 the only developing thing of course is the wisdom tooth that we're looking at. To assess the wisdom tooth and the development of the wisdom tooth it's necessary for us to take an image, a radiographic image. That is the OPG that Dr Low had just referred to. I don't

know how many OPGs are taken during a year in Australia but it would be in the thousands. So the efficacy of safety, although it is an issue, I do not dispute this, it is low on the danger list.

Despite the incredible amount of robust research that has been done and the investigation and scientific research that has been undertaken over the years, looking at and focusing on the development and the maturation of the wisdom tooth, we are unable to state definitively the age of the individual. In other words we can't say this person's 18, we can't say this person's 18.5, we can't say if this person's 19 at all. We are not able to do that. But what we are able to do with ongoing research and ongoing science is that we are able to reduce the parameters of our confidence intervals and our standard deviations to the point where we are comfortable with stating that a person is 18 years of age plus or minus 1.2 years.

So this is the age range that we are going to present to the legal people of this land. Many of our detractors will say that this is totally unacceptable. That can't you be more accurate than this. We can't. Therefore if you cannot be more accurate in this age assessment and your standard deviations are one year, 1.2 years, then what is the point of doing this?

My contention is that by giving an age range, we are in actual fact assisting the courts of the land. Because we are allowing the courts to look at the evidence on the balance of probability and we are also according a child the benefit of the doubt in any decision that is made. We cannot be more specific in what we are saying to you.

Now much has been written about multifactorial approaches to this. We should be looking at chest X-rays, clavicles, hand-wrist, development of psychological parameters that may also assess the age of this child. There's no actual proof that this here will assist in the age assessment. There's no scientific evidence that this would assist in any age assessment at all, in fact, it could work in the opposite direction in that it would delay any final decision on a child who is incarcerated within our system. Because if you produce more systems, then it can become delaying and lengthening of the process of this investigation.

However, as I intimated before, to rely upon one radiograph, whether it be a hand-wrist radiograph or whether it be a radiograph of a developing wisdom tooth, to rely upon that one factor in determining the age of a person is clearly, clearly wrong. We must have a multifactorial approach to this. The only

multifactorial approach that I can see which is non-invasive, which is safe, is a full dental examination.

By examining as a dentist in general practice or as a forensic dentist, when I am confronted with the examination of an individual, I do not focus on one element of their person. In examining any individual I will be looking at the head and neck region and the external features, I will be looking at face, lips, nose, I will then concentrate on intraoral examinations, looking at gingiva (gum tissue), looking at teeth, the cavities, missing teeth, wear facets on teeth, how they are worn. I will be looking at bony lost from within the mandible and the maxilla. I will be looking at abrasion areas around the teeth, I will be looking at the gingiva in the palate, I will be looking at the tongue.

All these elements change with age. They are specific changes with age. So I am in my process of examining this patient, we are introducing this multifactorial assessment of how old is this individual. I can tell by looking and doing this examination properly, the difference between a person who is 18 years of age and a person who is 25 years of or 30 years of age, who purports to be somebody who is 18 years of age.

Catherine Branson: Thank you, Dr Hill. Just exploring that last part first if I may, before we move on? Would Australian experts who hold qualifications similar to yours have any experience about what, for example, the nose of an Indonesian fisherperson would look like at 19 as opposed to 15? What their lips might be looking like, things of that kind, particularly if they'd been engaged in outside labour of a difficult kind in weather conditions quite different from those experienced by most Australians?

Dr Anthony Hill: No, we wouldn't know the difference, but we're not looking at that difference. What we're looking at is the texture of the skin; we'd be looking for any changes in skin which - I'm looking at tumours, which are more commonly seen within this group of people. We would be describing these. Do we have data on this, no.

Catherine Branson: That would make it rather difficult to assess the reliability of the opinions, wouldn't it Dr Hill? [Inaudible] things, yes?

Dr Anthony Hill: [On those things] yes, I agree. But what I'm saying is that when you accumulate this sort of evidence it will strengthen and make your report more robust.

Catherine Branson: Thank you. Again, just for clarity, am I right in understanding from what you say that the only relevant technique, apart from visual inspection, that you're

speaking of, as being useful to determine whether someone's over or under the age of 18 years, is the OPG X-ray of the third molar?

Dr Anthony Hill: I would be looking at the OPG of the third molar and structure, yes.

Catherine Branson: There's no other dental technique that you would advocate for, for being useful to determining maturity?

Dr Anthony Hill: A simple examination, intraoral examination with a radiograph, yes.

Catherine Branson: I know this is a little unfair Dr Hill, but I did hand you today, this morning - and you may not have had a chance to read it, an article that was drawn to my attention yesterday and that's why I wasn't able to give it to you before. I think you're the only person in the room that has it, apart from me, in front of them. If I could read from the front page, it's an article on the topic third molar agenesis and craniofacial morphology.

It's published by a PhD student and what would appear to be two supervisors from the University of Murcia in Spain, published in the journal *Angle Orthodontist, Volume 79, Number 3*. It includes this in its introduction. The third molar is a tooth characterised by the variability in the time of its formation, by widely varying crown and root morphology and by its varying presence or absence in the mouth cavity. Agenesis of this tooth is frequent, although its frequency ranges widely and then it gives variability's from various populations. First, is that a publication that you know?…

Dr Anthony Hill: No, this is not a publication [unclear].

Catherine Branson: I mean the *Angle Orthodontist*; I don't mean the particular article.

Dr Anthony Hill: Oh no, no, yes I know the journal.

Catherine Branson: Is it a reputable, reviewed journal?

Dr Anthony Hill: Yes.

Catherine Branson: The university is one of high repute, I assume?

Dr Anthony Hill: Absolutely, yes.

Catherine Branson: Were you aware of that statement about the third molar having been published in this journal?

Dr Anthony Hill: No.

Catherine Branson: It does seem on the face of it to make youth reliance on the third molar apparently problematic. Is there anything you could say about that?

Dr Anthony Hill: Basically - well agenesis for a start means that…

Catherine Branson: That you don't have it.

Dr Anthony Hill: …it doesn't happen, if you have an OPG where there's no third molar. Unfortunately I can't help [unclear]. This…

Catherine Branson: And we don't know the rate of agenesis of the third molar in Indonesians presumably?

Dr Anthony Hill: No, absolutely not. I am not aware of that. The statement that the third molar is characterised by the variability in time of its formation, I find that statement to be incorrect. We know from the amount of research and the quality of the research we have figures as to when this tooth begins to form, when it first appears on a radiograph at 10 years of age, when it is in its crypt generally and the process and the stages of its calcification of its crown and of its root formation. We have [unclear] of that. I find that statement to be just [unclear]. It needs further clarification I think.

Catherine Branson: Dr Hill, again before we move on, you don't, I think, in your written submission to the Commission, give a level of confidence about age assessment from the third molar, but others have done so. The King's College London Dental Institute and I think you're in contact with Dr Roberts. They, in their recent submission, gave a figure for the attainment of stage H and that's what you were speaking of I think, isn't it?

Dr Anthony Hill: Yes.

Catherine Branson: That attainment of stage H for permanent molars gives a probability of 67.03% that a male individual is over 18 years. That appears at page 38 of our volume. Is that the level of confidence that you would assert?

Dr Anthony Hill: I don't use confidence levels because basically what we're saying here is that in 61% of the cases we've got it right, but in 39% of the cases we've got it wrong. I don't want to be sitting in the 39% of cases where I'm wrong and I've offered this opinion. I mean that's not really good odds. What I'm saying is that we should not be talking about these confidence intervals, we should be talking about this person is 18 plus or minus. The decision as to how this person is treated doesn't rest with me; it must rest with the court. So we can only assess the court in manner. I would not like to be saying this person - I'd get this 39% of the time wrong.

Catherine Branson: Professor Cole? Are you still with us Professor Cole?

Professor Tim Cole: Yes, I am.

Catherine Branson: I think you need to speak to get the camera on you. Professor Cole, would you like to say something about the use of dental X-rays? In a general sense, not particularly targeted to this population?

Professor Tim Cole: Yes, I have worked with Professor Graham Roberts. I have acquired some knowledge of dental age assessments. My understanding also of the key question is stage H of the third molars that one should be focusing on. There's an important point to make here which is exactly analogous to bone age, based on the hand-wrist X-ray. One cannot talk about the age of an individual based on their stage H third molar. One can only talk about the age when that third molar reached stage H. If you talk about that point then you can make a statement about the mean age and you can give it a standard deviation and you can extract a probability from this.

That's what Professor Roberts is doing on page 38. One difficulty is that the way he calculates the stage H age of attainment is wrong. I don't think I'll go into the technical details now but he comes up with an age which I think's too high and he also comes up with a standard deviation which is too high. It requires a different sort of analysis, which I've done, and that gives a mean age for stage H molars of around 19.6 years with a standard deviation of 1.3 years.

The general points I was making about bone age being uninformative, exactly the same argument can be applied to the dental age in terms of the likelihood ratio. It again comes back to the fact that the standard deviation of the difference between chronological age and age of attainment of stage H is about 1.3 years. It's fairly consistent whatever measure of developmental age you use. So I'm led to the conclusion that dental age is, like bone age, too variable to be informative to the court.

Catherine Branson: Thank you. Dr Hofman, Dr Onikul, is there anything that either of you wish to say on this topic?

Dr Paul Hofman: I don't see myself as an expert at all, in…

Catherine Branson: Now, Dr Low I don't think you wish to contribute further to this debate, is that right?

Dr Vincent Low: I'm fine. I enjoy listening.

Catherine Branson: Right, very well. Professor Cole there's been a recent exchange by email between you, I think, Dr Hill and Dr Roberts from the King's College. I wonder if you could help me understand precisely what that's about, because I have to say, it was a little too technical for me to follow.

Professor Tim Cole: Well I agree, it was a little bit opaque to me as well. But I think the central issue is what is the mean age of attainment of the stage H third molar and what is the standard deviation. Professor Roberts came up with some numbers which he found were inconsistent with the numbers that I quote in my submission. If the mean age is over 20, which is what he was claiming, then the chance of somebody being under 18 is considerably smaller than if the mean age is around 19. So he was rather concerned that I, using his data, was coming out with a relatively low mean age and hence a rather different probability from what he was getting.

But as I said, the difficulty is that he is not calculating the mean age of attainment in the right way. I'm sorry that he's not here to respond to that. But it requires a particular statistical analysis, which I know from the way he's described what he's done, that he's not done it correctly. In fact, I do wonder whether the literature on this has calculated the mean age of attainment of stage H - I probably need to do a literature search to get an answer on that. Certainly Professor Roberts doesn't use the right technique. I'm sorry, does that help with this?

Catherine Branson: Yes, thank you. It may be that Dr Hill can help us in a moment, but do you have that exchange in front of you now Professor Cole? The email exchange with Dr Roberts that Dr Hill was a party to?

Professor Tim Cole: I think I have the document you're referring to, yes. It's with a table and some numbers, is that the one?

Catherine Branson: That's the one. It appeared to me looking at that first table, which has a percentage age probability that the subject would be over 18 years of age calculated, with the percentage being on the right hand side of the page, that that is a percentage probability appreciably higher than that which was calculated in the formal submission to the commission by the King's College London Dental Institute. Am I right in reading it that way? That the one figure was roughly 67% and these are percentages between roughly 83% and 90%.

Professor Tim Cole: You're absolutely right and I'd made the same observation, the two are inconsistent.

Catherine Branson: Dr Hill you might - you've, I think, been in conversation perhaps or at least in communication with Dr Roberts. Can you help us with this?

Dr Anthony Hill: I state right here and now I'm not a statistician by any stretch of the imagination. My understanding was that there was discussion between Dr Cole and Dr Roberts regarding the use of the data, how your figures were arrived at Dr Cole,

and that Dr Roberts believed that you were using an older version of his present data and that you had combined males and females within your calculations. He has separated males out from females. There was also some difference in his treatment of the data, where he was looking at lower wisdom teeth and not combining upper and lower wisdom teeth together in your calculations.

Lower wisdom teeth develop at a later date than upper wisdom teeth and by combining the two of those, the upper and lower within the stats; it may slew the figures slightly.

Catherine Branson: I understand from that, and please tell me if I'm wrong, is that the area of potential disagreement might either be about statistical method, as Professor Cole says, or it might be about identification of the precise data appropriate to be used as you say, understanding what Dr Roberts is saying?

Dr Anthony Hill: Yes.

Catherine Branson: Can either of you identify a means by which I might be able to work out whether it's an issue of statistical method or an issue of accessing the right data? Go ahead Professor Cole.

Professor Tim Cole: The key issue is the statistical methodology, the way in which one should calculate the mean age from the data. Certainly one gets different answers doing it the correct way, using logistic regression, from the way that Professor Roberts does it. I mean the points that Dr Hill's made about mixing males and females and mixing upper and lower teeth it is true that I did that, but I did it because the difference between the two sexes, in the database that I have, was very small, so there seemed to be no point distinguishing between them. I wasn't looking at individual teeth; I was looking at the earliest third molar.

So I was thinking of a situation where one sees an Indonesian fisherman and you ask yourself the question, do they have at least one stage H third molar. I don't care whether it's an upper or a lower molar, the question is have they got a stage H molar. So that was the basis on which I did the analysis. So as far as I'm concerned, those considerations about the individual tooth and the sex are not really germane to this discussion.

Catherine Branson: I think you've identified a method, but I might ask you to do it again, by which you calculated the age of attainment of stage H of the third molar from the data. Could you also tell us how you understand Dr Roberts has undertaken the same exercise so that I can see side by side by description the two methods?

Professor Tim Cole: Okay, well let me describe simply how I did it…

Catherine Branson: Could I just say Professor Cole - sorry, just to stop you. Could I say it's possible that I won't understand what you say, but I am seeking an…

Professor Tim Cole: Well you will.

Catherine Branson: …explanation that I could easily show to somebody else who might understand.

Professor Tim Cole: No, no, no, you will understand, there isn't - no, no, no. We focus on one particular third molar and we look at people from all ages, from birth all the way up to adult and we split them up into age groups, say whole years. So we look in the first year, aged nought, and there will be lots of children there and they all won't have third molars at all, stage H or otherwise. Then we move up through the age groups to say age 10 and we'll start to see some of the third molars at lower stages, but we're only interested in stage H.

So we can calculate the proportion of children in each year group who have got stage H. That proportion will run along at zero until we get to about age 14 or 15 and it will then start rising slowly. At some point it will reach 50%. That is the point where that is the mean age of attainment and it will then continue to rise beyond 50%, up to 80%, 90%, to 100% when you get up to age 22-25.

So you can just imagine that graph in your mind that the probability in individual age groups raises from zero, through 50%, up to 100%. So that is the correct way to do it. You can do that formula using logistic regression.

Now, Professor Roberts doesn't use the non-stage H data, he only uses the stage H data. He calculated the mean age of the people in his database with a stage H. Now clearly that could include people who are 100 years old, which would rather distort the mean age. To get round that he uses a cut off of plus three standard deviations, but ultimately it's not the right way to do it and it's very open to bias. So that's why the two come up with different answers.

Catherine Branson: Thank you. Dr Hill, could you help us in this area at all? If you're not a statistician and that's what you want to say, please feel free to say so.

Dr Anthony Hill: I am not a statistician and the stage H that we are looking at, maybe we should pose the question, what is the earliest age at which this stage H, in other words, the complete formation and closure of the lower wisdom teeth - and I'm talking about the lower wisdom teeth. Then what is the lower age at which this is seen Professor Cole?

Professor Tim Cole: Professor Roberts has got that statistic; he's extracted it from his database. I personally haven't, because it's not critical to my way of extracting the mean

age of attainment, but it will be around probably, I would guess age 14, something like that.

Catherine Branson: Right, thank you. I should say Dr Hill, because I don't want you to feel under unreasonable pressure here. I have agreed with Dr Roberts to provide him with a copy of the transcript today - there were a number of reasons that made it difficult for him to be included in today's hearing - and he would have an opportunity to comment, and Professor Cole, of course, I will show you what it is that Dr Roberts says. It is an issue worth pursuing and ultimately with such assistances I will get I will try to make a judgement about it if I find it necessary to do so.

But I think on your methodology, Professor Cole, the probability of an 18 year old generally having already attained one or more stage H molars is 24%, is that right?

Professor Tim Cole: I think that's the figure I quoted.

Catherine Branson: I think appears at page 34 of your submission, I think.

Professor Tim Cole: Yes. Okay, that's correct.

Dr Anthony Hill: The latest research that we have - and this is a PhD that was done in Melbourne over the last year, certainly was concentrating on looking at a population of Australian youngsters. The findings from that PhD research stated quite clearly from that the evidence that total closure and total maturation of the wisdom tooth occurred at age 18 in 96% of the individuals that were looked at. In other words over the age of 18, 96% of people had their wisdom teeth fully formed.

Catherine Branson: That would be entirely consistent with what Professor Cole said I think, wouldn't it? Professor Cole?

Professor Tim Cole: Umm…

Catherine Branson: I think it's the same differences we experienced with the wrist X-rays. One person talking in terms of percentage who have it at a certain date and the other person speaking of the age at which they attained it? That's right Dr Hill?

Dr Anthony Hill: Yes, I'm not quite sure that…

Catherine Branson: Whatever you say is the probability I think the method - the different approach, it's the same different approach.

Dr Anthony Hill: Yes, simply different approaches have the same data and the results that are coming out pretty well just about right.

Catherine Branson: Yes. Thank you. I just noticed, Dr Hill, and I should draw it to your attention, because I drew the other article to your attention, that in the submission you have from the George Institute for Global Health, which is at page 113 of the volume we have, that institute submitted to the Commission that a recent systematic review of third molar estimation in various American population groups reinforced a requirement of the use of population specific studies when estimating age from dental X-rays within a number of noted American populations, varying rates of this molar development were seen. Do you want to make a comment on that observation?

Dr Anthony Hill: Again, there are debates in this field. I have quoted in my submission that basically ethnicity does not greatly influence the age of dental maturity and they are submissions that I've given here - the reference that I've given here relate to this specifically, and also there was recent material that was gathered by Roberts in the UK, where they looked at a UK group of people, the people from Southern China, people from Eastern Turkey, people from Austria and black Africans. The overwhelming evidence was that ethnicity does not greatly influence the age of dental maturity.

We have seen that in Australia. Between all the studies that we have done between people in Perth, people in Victoria, people in - and also looking - this is only very, very small numbers, looking in Indonesia and in Thailand and in Hong Kong as well.

Catherine Branson: Right. Could you tell me what information from Indonesia you have about third molar development?

Dr Anthony Hill: This is work that is being undertaken now, it's still in the progress by one of the students that did the diploma course here in forensic odontology and part of her research is looking at ageing and age assessments of Indonesian and Thai people.

Catherine Branson: So it's not material that I can access?

Dr Anthony Hill: No, it's not at this stage.

Catherine Branson: Unfortunately.

Dr Anthony Hill: I will definitely try and find some.

Catherine Branson: All right, thank you. So as far the George Institute made the statement which is in page 113 of our folders, which I read out, are you suggesting that their opinion is either - I think you must be suggesting either they're just inaccurate or

there's something about American population groups that makes them standout or is it something else Dr Hill?

Dr Anthony Hill: I believe that what they're stating there is not outside the realms of what we're saying here. There are subtle differences but they are of very little consequence to what we are doing in our age assessments.

Catherine Branson: All right. Then if we turn - unless anyone wants to raise anything more about the general use of dental X-rays to their - a topic we've already started to touch on, the use of them to determine whether young Indonesian males who come out on people smuggling boats are likely to be over the 18 or under. Dr Knott, who you'll know I think, is quoted by the former Attorney General as having said that adequate databases are available to make an age determination of a person from Indonesia by analysis of dental X-rays and that the procedure is commonly used in the United Kingdom.

He advised that a comparison of an Indonesian national with the available databases would have a variation range of zero to 12 months and that the available research indicates 90% of a given group of individuals will fall within this variation range, the remaining 5% will fall outside the range, through genetic and environmental factors, but it's not possible to identify those individuals. Are you in agreement with Dr Knott on that statement?

Dr Anthony Hill: I am in agreement. Yes, absolutely.

Catherine Branson: Professor Cole, you don't have that in writing. Were you able to hear what I read out?

Professor Tim Cole: Yes. I can't say I totally assimilate it in my rather bemused state but I think probably…

Catherine Branson: I could read it again if it would help?

Professor Tim Cole: Perhaps could you bear to read it again please?

Catherine Branson: Yes. So Dr Knott has reported that adequate databases are available to make an age determination of a person from Indonesia by analysis of dental X-ray and that this procedure is commonly used in the United Kingdom. Dr Knott advises that a comparison of an Indonesian national with the available databases would have a variation range of zero to 12 months and that the available research indicates 95% of a given group of individuals will fall within this variation range. The remaining 5% will fall outside the range due to genetic and environmental factors, but it is not possible to identify those individuals.

Professor Tim Cole: Well I certainly agree with the final comments, you can't identify individuals. I have a disquiet about the way those numbers have been calculated, which goes back to the point that I was making that Professor Roberts doesn't calculate the age of attainment in the correct way and I wonder whether other studies do. So I can't agree categorically with what you've said.

Catherine Branson: All right. Dr Hill, you might be able to help me. When it's reported that Dr Knott advises that a comparison of an Indonesian national with the available databases would have a variation rate of zero to 12 months. Does that mean a variation zero to 12 months wider than the population on which the database is calculated or something else?

Dr Anthony Hill: I think looking at what Dr Knott is alluding to is that when he is asked to assess the age of an individual he will give you an age range. Therefore he would say I believe this person to be 17 years of age, plus or minus one year. I think that is what he is alluding to, not on a general population, the Indonesian population. He's looking at a specific person based on the database this person could - and if they fall in that Bell Curve…

Catherine Branson: But every database has a variation range in it doesn't it?

Dr Anthony Hill: Yes, correct.

Catherine Branson: Right. What I'm interested in is whether you think - perhaps I should concentrate on your opinion. Whether from the databases that we have, if you use them to assess the age of someone from Indonesia you need to expand the area of uncertainty - that is the variation range, to take account of the fact that the database is almost certainly not Indonesian based?

Dr Anthony Hill: No.

Catherine Branson: You don't believe you do?

Dr Anthony Hill: No.

Catherine Branson: Can you expand on…

Dr Anthony Hill: I don't believe that ethnicity will have any substantial bearing upon what we are trying to achieve.

Catherine Branson: But if you leave ethnicity aside, as we discussed it before, there are a lot of things about this cohort of young people that we don't know. Would that cause us to want to be cautious about even plus and minus one year, when we were dealing, for example, with a database that we knew worked for the Australian population?

Dr Anthony Hill: I don't think we should be afeard by it at all.

Dr Paul Hofman: Can I just ask…

Catherine Branson: Yes Dr Hofman.

Dr Paul Hofman: Dr Hill, you made this point earlier that your database on the third molar was looking at plus or minus 1.12 years, that's in a standard deviation?

Dr Anthony Hill: Yes.

Dr Paul Hofman: Which is basically two years either side for…

Dr Anthony Hill: Correct.

Dr Paul Hofman: Okay. Now this database here says you're looking at SD which must be less than six months if you're looking at age variation of only a year. Why is there a difference, because that's quite a big difference?

Dr Anthony Hill: Sorry, no, I'm not saying that at all. I'm not saying it is only six months, I'm saying…

Dr Paul Hofman: Oh no, you weren't, but this group in the UK were stating that there was a variation of a year for [unclear] 95% confidence levels…

Dr Anthony Hill: Is this the Roberts group you're talking about?

Dr Paul Hofman: Yes. So there was a big difference between your…

Dr Anthony Hill: Yes, absolutely, because Roberts and his group, the amount of data that they have accumulated is far vaster than ours, bigger than ours. As I say, the more research that is going on into this, the parameters of this standard deviation's becoming less.

Dr Paul Hofman: Yes, see I disagree with that because I think biological variation won't change but I'd be interested to see what Professor Cole says. I have difficulty pulling those numbers together because I don't think it's simply a number issue. I wonder whether there's something else happening.

Catherine Branson: Professor Cole can you help us on this?

Professor Tim Cole: Well I agree very much with Dr Hofman. Variability is going to be at least as wide as we've heard for bone age. The standard deviation is going to be in excess of one year so any confidence in it will be plus or minus at least two years.

Personally I don't understand the statement by Dr Knott about the nought to 12 months. But if he's referring to the Roberts group I just wonder if they're talking

about a mean dental age. Does it explicitly say that they're talking about the age relating to a stage H third molar in what you read to me?

Catherine Branson: No, I was reading…

Professor Tim Cole: I think you may find that that is completely irrelevant to our discussions, because generally speaking the Roberts group are not that interested in stage H, they tend to focus on stages A to G.

Catherine Branson: We do have Dr Knott's own submission to the commission which appears at page 63 of the volume that we all have. So it may be that people with greater expertise than me could identify from that precisely what he was being reported as having said? Sixty-seven is the start of his effectively.

Professor Tim Cole: I think this might take a few minutes to read in detail.

Catherine Branson: It's not a particularly detailed submission Professor Cole and the substance of it really is on page 67 in that long paragraph under chronological age related to dental radiographic images. So it's more [unclear] research than support but an expert opinion nonetheless.

Professor Tim Cole: Well it refers to publications 19 to 33 that relate to maturation of the third molar, but I don't think it actually says anything about that other than actually other than that you can't give the specific age.

Catherine Branson: That's right, and we have his references.

Professor Tim Cole: I don't think this is going to clarify the quote that you read out.

Catherine Branson: No, probably not. Oh well. Dr Hill if I could go back to you. In page seven of our volume which is in your submissions, you speak of any assessment of third molar development needing to be undertaken by a panel of specialists experienced in the interpretation of both the OPG and dental development. Can you tell me slightly more specifically what you had in mind?

Dr Anthony Hill: I believe that looking at development of, or the maturation of the wisdom teeth, is not simply the domain of dentists. I believe that we should have other people who have expertise in age assessment also looking at other practice that we're looking at.

I am proposing that the investigation should be headed up by a dentist simply because we are focusing on the dentition teeth and that is our field of expertise. I believe we should have radiographers with us on a panel, we should have paediatricians with us on a panel, I believe we should have orthodontists on that panel, I believe we should have other experts within this field, so that you

are not going to get a skewed or biased dental opinion. You will get an opinion across the board from various experts within this field.

Catherine Branson: Dr Hill from what you've said I think you're envisaging a panel of six or more expert medical practitioners or dental practitioners of one sort or another, is that right?

Dr Anthony Hill: Yes.

Catherine Branson: If you turned your mind to what the cost to the public purse might be of using such a panel, with respect to every Indonesian national suspected of people smuggling who asserted that he was a child?

Dr Anthony Hill: We need to have one dentist, who is examining the client. We need one radiographer who will be taking one OPG. That OPG can be digitalised and can be sent around Australia. We do not need to convene a board of people; we do not need to convene anyone. This can all be done digitally and securely and that opinion can be sourced and can be arrived at within a matter of days, very simply. Then a report would be written by the forensic dentist, the forensic odontologist or whoever's heading this panel and can be again sent to a commission, sent to a court, sent electronically.

But the cost to the community - well the cost to the community quite frankly, if we get it wrong, is far outweighed by what it's going to cost us and what it's going to cost us to set up the taking of an X-ray. Every state and every capital and every area in Australia where these people are housed, imprisoned, has radiographic facilities. So it's not as those we are expecting extra funding to do this.

Catherine Branson: Thank you.

Professor Tim Cole: Could I comment?

Catherine Branson: Yes Professor Cole.

Professor Tim Cole: There's a belief that if you collect extra information you can come up with a more precise estimate of age. I mean the first thing to say is that this is optimistic because many of the measurements that you will be making will be correlated with each other so they'll all tend to give the same answer anyway, but the much more important point is that if you are going to combine information from lots of different directions then you have to operate to a very tightly developed and validated protocol so that you cut out personal bias in the way that individuals assess whatever particular marker they're going to assess.

So I would argue (a) you're not likely to improve precision by using a multidimensional assessment tool and the difficulty involved in setting it up, developing it and validating it would rule it out in practice in anyway. So I would say very bluntly that the idea that you can take lots of different measurements and come up with a better answer is pie in the sky.

Catherine Branson: Thank you. Are you still with us Dr Low?

Dr Vincent Low: I am indeed, Ms Branson.

Catherine Branson: Is this a matter on which you'd like to express an opinion?

Dr Vincent Low: Well, I've made a couple of notes. I'd like to ask a couple of questions of relevant people which may help to understand or dispel some of the confusion which has existed - that you mentioned about the differences in the results. The first question I have to ask Dr Hill is, as I saw with X-ray of the hand, socioeconomic status had the most significant effect upon maturation of those bones. Is that something similar that's observed in the third molar?

Dr Anthony Hill: No. The simple answer is the development and the maturation of the third molar does not appear to be affected by external environmental factors that you are alluding to. Only in extreme cases of medical complications would this occur - medical issues, would that occur. But no - and I've quoted in my references here articles that have looked at changes in growth and development of the maturation of the wisdom tooth, as it is affected by lack of food, of other medical conditions, and it would appear that the entire dentition is not affected to the degree than bony development and skeletal development is.

Dr Vincent Low: Thank you, you've answered the question the way I thought you would because that was the impression I had. Even though I'm a radiologist I actually view for my dental colleagues probably a dozen or so OPGs every day.

I asked that question because (a) I was surprised to hear the differences that you mentioned in the paper from America and I thought maybe there was some vast difference in economic status of those particular groups but that remains unresolved.

The second question I had to ask was when Professor Cole was assessing those statistics was he using the study which included the top molars as well as the lower molars. May I ask Professor Cole that please?

Catherine Branson: Professor Cole?

Professor Tim Cole: I'm sorry. I'm not quite sure which particular thing you're referring to, but the…

Dr Vincent Low: Earlier on there was a…

Professor Tim Cole: The analysis that I did myself was focusing on whether or not an individual had at least one stage H molar.

Dr Vincent Low: Which means all four quads?

Professor Tim Cole: Any of the four, so it's a workable definition for somebody wanting to look in a mouth and say is this person mature or not. I can't myself see the point of looking in a mouth and saying has this person got their lower left third molar and ignoring the other three. It just doesn't seem a sensible way to go. So I used a workable definition which is have they got at least one stage H third molar. I don't see that it's going to make a dramatic amount of difference. It's going to be earlier than any individual…

Catherine Branson: Thank you very much Professor Cole.

Dr Vincent Low: I'm going to ask again and Dr Hill can help me with this one. Isn't that important in my everyday practice I see a lag and it's found now in the books as well, a lag between upper and lower molar development. So if Professor Cole is measuring any molar development and you're measuring lower molar development, the data's going to be vastly different?

Dr Anthony Hill: I'm in total agreement with you. The reason that he focused on lower molar teeth, lower eights is because in the OPG radiograph the upper eight is commonly distorted - the image is distorted and it is very difficult to interpret what you're actually looking at. In the recent studies we have looked at in Victoria, the development of the left wisdom tooth, the development of the lower left and the lower right wisdom tooth parallel each other, we have yet to see a lower wisdom tooth on the left that is not at the same development range of maturity as one on the lower right. But we do know that the upper wisdom teeth develop and mature ahead of lower wisdom teeth.

Therefore combining the upper and the lower in any statistical measures will slew those results. That is my conclusion.

Catherine Branson: Thank you. Is there anything you want to say about that?

Dr Vincent Low: I would agree.

Catherine Branson: Thank you, Dr Low. Professor Cole, is there something you want to say about that?

Professor Tim Cole: I'm not quite sure why one would want to focus on one particular molar. I accept that the lowers appear - sorry, I don't know which way round it is, whether the

lowers tend to appear earlier or later than the uppers. But there will be situations when individual molars come out in the wrong order. There is variability there. You cannot guarantee they'll come out in the right order.

So it seems far more practical to me to use as your definition of maturity any third molar stage H, whether it's in the upper or the lower mouth. I don't understand one has to - I mean why if I look in the lower part of mouth and there's no stage H's there but there are in the upper mouth - I've got it the wrong way round. I'm expecting them to be in the upper mouth but suppose they're in the lower mouth, does that mean the person isn't mature? I don't follow the logic.

Catherine Branson: Thank you. Is there a logic Dr Hill?

Dr Anthony Hill: Yes there is.

Catherine Branson: What is it?

Dr Anthony Hill: What we are looking at here - and Professor Cole alluded to when they come out. You're talking about eruption Professor Cole and we are not…

Professor Tim Cole: No I'm not talking eruption, I'm talking stage H development.

Dr Anthony Hill: You mentioned when they come out. Now there are some wisdom teeth in the lower jaw…

Professor Tim Cole: Well, that's what I meant. Forgive me if my terminology was wrong, I meant stage H.

Dr Anthony Hill: Yes, I'm sorry. But they still develop within that bony crypt and we are looking at the development, not the eruption of the tooth, we are looking at that stage H and it is on radiograph, on OPGs, the lower eights are far better to view, to look at and to assess your stage H, as opposed to an upper eight, an upper wisdom tooth, which is distorted, which is difficult to visualise and therefore the stage H is difficult to assess. When you combine the upper eight, which develops (word is inaudible but not offering anything substantial) with the lower eight, then that is going to throw the stats out. I think we should be looking at the most easily visualised tooth on the OPG.

Catherine Branson: Professor Cole, two sentences on that and then we'll stop this debate I think. Do you want to respond in a very short way to that?

Professor Tim Cole: With respect I disagree. I think Dr Hill is trying to do something I'm not. I want to come up with a simple screening system so I look at somebody's OPG and I

say has this person got evidence of a stage H molar and I don't care whether it's upper or lower. If he wants to do something different then that's fine.

Catherine Branson: All right. Now the final question I wanted to ask on this topic is what is the atlas or database that we should be looking at when assessing age, as best we can, from dental X-ray? Dr Hill?

Dr Anthony Hill: We should be looking at an OPG…

Catherine Branson: That's a methodology isn't it? What is the comparison database? Or don't we need one?

Dr Anthony Hill: Yes the research… We're not going to look at an atlas and compare the development of this tooth here with what we see in an atlas, no. We're going to look at the development and the maturation of that eight and we will assess that from - not an atlas, but from data that's gathered from research.

Catherine Branson: What is the database that should be used?

Dr Anthony Hill: At this stage here, we're limited to using a database from the UK.

Catherine Branson: What is that database? Is that the King's College London Dental Institute database?

Dr Anthony Hill: Yes, correct. We do have a database from Victoria that has recently, as I said, been published in a PhD. That was in a submission from Dr Bassett that was sent in from the BIP. That database we had which is specifically relating to [unclear] material in Victoria.

Catherine Branson: There are at least three dental development atlases that have been drawn to my attention. You would not use any of those, is that right? No. Professor Cole, do you have a view about that?

Professor Tim Cole: To be honest I don't. I'm aware of the Roberts database because I've used it myself. I don't know what else there is available.

Catherine Branson: No, thank you. Well unless anyone here thinks there is more questioning that we should engage in around Dental x-rays, I think we should contemplate having a break now. Dr Hill is there anything else that you think we should be looking at around dental X-rays?

Dr Anthony Hill: I think we've covered most of the issues. I realise that there are obstacles that need to be overcome, I do realise that and I realise that we cannot be age specific. We must be giving age range if we are going to get any meaningful stuff out of this here at all.

Catherine Branson: Professor Cole is there anything further you think we should be exploring about dental X-rays now?

Professor Tim Cole: Could I make a quite general comment. Any sort of measurement of developmental age, be it based on bone age, dental age, clavicular age, anything else, all of these will involve uncertainty and a standard deviation of in excess of a year. This means that they are all too uninformative to be useful to the court and therefore I would say that there is no point trying to use a measure of developmental age to guide the court in somebody's age.

Now, I realise that this is a rather extreme position to take, but it is the reality and really the courts have got to recognise that they can't rely on these noisy estimates of chronological age based on development, because of all the difficulties associated with it. I think something radically different needs to be thought of.

Catherine Branson: Thank you. Professor Cole, I'm proposing to take a break now because people have been sitting for a long time, but I'm very alert to how late it is for you. The other issues I'm proposing to explore in the remaining part of the morning, are issues of the ethical dimension that's of using wrist of dental X-rays and what, if any, information this group can usefully provide to assist me in thinking about how a recommendation ought to be formulated with respect to age assessment for this group of young people.

If you would like to make some observations now and then excuse yourself to go home to bed that would strike me as being very reasonable and I would sit while you did that. Alternatively, you might like to just take a short break and stay with us; the choice is entirely up to you.

Professor Tim Cole: Well I'm grateful to you for offering me the alternative. I think I would rather let your other learned advisors talk to you about the ethical dimensions of the X-ray exposure and indeed possibly the prejudice of people who are relatively advanced in their maturation. I think I've said enough on that, so if I may I will accept your invitation and slide away.

Catherine Branson: All right. Well Professor Cole, could I thank you very much for your taking part of this hearing at a deeply inconvenient hour for you. I appreciate very much your willingness to do that and I'm very grateful for the assistance that you've given me in what has been morning for us here. I thank those who are there with you operating the machinery, I'm grateful to them also for having stayed up late. Thank you very much.

Professor Tim Cole: Thank you very much indeed for inviting me; it's been a pleasure to take part.

Catherine Branson: Thank you. Feel free to wander off when you're ready Professor Cole and we'll all now take a break for 10 minutes.

[Aside discussion]

Catherine Branson: So before we proceed I've been invited to ask each of the three of you whether there is any medical procedure that is precise for the purpose of age determination, even if that age is not 18. I don't think I'm asking about three or four but is there an age determination that might be precise at 20, or 19 or 17. Anything of that kind that any of you know of? Starting with you first Dr Hofman.

Dr Paul Hofman: Not as far as I'm aware. It'd be great if we were horses, but we're not. The range of puberty means that virtually every biological assessment has to follow that range, so you're looking at a range of five years roughly, even with the most accurate.

Catherine Branson: Dr Onikul?

Dr Ella Onikul: No, there's nothing precise. There's a way, for instance, with a pelvic ultrasound you can assess if a female is pubertal, pre-pubertal or post pubertal, but that has nothing to do with her chronological age because it varies.

Catherine Branson: Dr Hill?

Dr Anthony Hill: No, not dentally, no. Nothing that I'm aware of at all.

Catherine Branson: Thank you very much. Very well, well then let's turn to the ethical dimensions or wrist and dental X-rays. I draw to everyone's attention that at page 50 of our volume - there's probably no need to turn it up. We have the submission from the Royal Australian and New Zealand College of Radiologists that expresses the view that - and I quote from the letter, the college considers it unethical to expose a young person to X-rays for purely administrative reasons. X-rays of teeth and wrist should not be used as evidence in a court of law because the age assessments obtained by these means are very inaccurate.

Now I know there's an interrelationship between the two, but the first statement, I think, stands alone. The college considers it unethical to expose a young person to X-rays for purely administrative reasons.

Could I ask each member now with us of their view on that issue? Dr Hofman?

Dr Paul Hofman: I would concur that I think using the ALARA principle, using the least amount of radiation possible is the way that we should be approaching any radiation which has potential for harm and I do not believe we should be using radiation for this purpose, irrespective of the fact that it's actually a very poor test.

Catherine Branson: Dr Onikul?

Dr Ella Onikul: Basically, certainly in recent literature any radiation is felt to be a problem. Although the dose of a radiograph is small, it is still a dose, both to the individual and to the greater society. With the ALARA principle, not only do we have to make it as low as reasonably possible, you have to have justification for doing the test. So if the justification is to try to make an assessment of the chronological age, and we cannot specifically do that, you have to question do we need to do the X-ray.

Catherine Branson: Thank you. Dr Hill?

Dr Anthony Hill: I agree entirely that any exposure to additional radiation is unacceptable. However, if you are going to try and do an age assessment from imaging of teeth or from imaging of bone, then radiographs are going to be necessary.

You state that legally we are in a bit of a bind here, it's not quite correct, because people are radiographed if they were smuggling drugs and so on. If we are doing radiographs then effectively we've got to report fully on the health of the individual that we see in that radiogram to [unclear] and put this into the guise of we're doing this for medical reasons and we're going to report on that, but where in actual fact we're doing it for age assessment, no. I think we have ethical problems that have to be resolved.

Catherine Branson: I think you'll all be aware that ARPANSA has published the - no I'm trying to think precisely what ARPANSA stands for. Who can remind me of that? The Australian…

Dr Paul Hofman: Australian Radiation Protection and Nuclear Safety Agency.

Catherine Branson: Thank you very much, Dr Hofman. They've published some codes of practice and the radiation protection series number 14 publication is a code of practice for radiation protection in the medical application of ionising radiation. I think we didn't give everybody a copy of that. Does anyone have a copy with them? No. You may be familiar with it, Dr Onikul, I imagine?

Dr Ella Onikul: I know some of it off the top of my head, but basically the standards are that whoever takes the radiograph should be qualified to do the radiograph along those lines, that the dose should be as least as possible and - in other words, people who are using the equipment should have a radiation protection type licence.

Catherine Branson: I'm just going to read out, if you wouldn't mind listening to me the three of you, what is in fact paragraph 3.1.3 of that publication. It's headed justification for a

medical radiation procedure. Now what I'd be interested in is whether you have any opinion about whether the content of this paragraph is easily applicable where you're using radiation, not for a medical procedure, but for a forensic procedure. If you feel it's well outside your areas of expertise please say, but if you have views on it, particularly you Dr Onikul, I'd be very pleased to know what they are.

So under the heading justification of a medical radiation procedure this code of practice says this: The responsible person, (now the definition of that) - means essentially those who are doing it or who are controlling the facility where it's done. The responsible person must have protocols in place to ensure that no radiation procedure is carried out unless (a) it's been justified, either (1) generically or on an individual basis by the radiation medical practitioner, in accordance with another clause, or generically by an acknowledged professional college or authority and (b) it's been approved for each individual by the radiation medical practitioner, or the operator, in accordance with written guidelines established by the radiation medical practitioner or an acknowledged professional college or authority. So there were two parts there.

There need to be protocols in place to ensure that no radiation procedure is carried out unless it's been justified, generically or on an individual basis, or generically by an acknowledged college and (b) it's been approved for each individual in an appropriate way.

But looking particularly at the first part, has anything that you have read in the course of preparing yourself for this hearing enabled you to form a view about whether the wrist X-ray procedure was justified either generically or on an individual basis, by a radiation medical practitioner or generically by an acknowledged professional or authority for the purpose for which it was being used?

Dr Ella Onikul: This is the real issue. Does a radiograph of the left hand, for bone age, is it going to give you a chronological age, which is what the court would like us to do. The answer is, it will not give you an absolutely definite chronological age, it will give you a range. So the question is, is the radiograph justified. Because the reason you were doing the test is to arrive at a definite answer. So in that sense, no.

Catherine Branson: It is the case, I think, from the paragraph I earlier drew to your attention, from the submission of the Royal Australian and New Zealand College of Radiologists, that the college of radiologists, of which I think you are a member

and Dr Low is a member, has said this procedure is unjustifiable. Dr Hofman, is there anything you want to say about that?

Dr Paul Hofman: The Australasian Paediatric Endocrine Group as a whole would concur with that and I know that my colleagues in the UK also feel very strongly along the same lines.

Catherine Branson: Dr Hill, is there anything you want to say about that, we're talking now of wrist X-rays?

Dr Anthony Hill: Yes, wrist X-rays are simply taken by a practicing orthodontist, looking not at age, looking at, as I said earlier, bone growth for future development. So there is absolutely no necessity we'd be opposed to taking those X-rays, when the results, based on an age, cannot be obtained.

Catherine Branson: So is this a fair understanding of what the three of you say, as I understand it speaking with one voice, the use of radiology for a non-therapeutic purpose is unethical unless there's special justification and where the evidential value, when it's taken for a forensic purpose is doubtful or at least limited, it would increase your ethical concern about taking the X-ray. Is that right? The three of you agree, yes? Thank you.

Is there anything further about - or is there anything different about dental X-rays, Dr Hill, that you want to draw to our attention in considering ethical dimensions of applications of X-rays?

Dr Anthony Hill: I come from the standpoint that I believe the - a radiograph of the dentition will be helpful to the courts in ascertaining age. That is my premise. If the court says yes we must look at the dental development, we cannot look at dental development without taking radiographs. Even though the radiograph that we are taking is being looked at for age, we would be ethically, morally bound, to report totally on what we are looking at within that X-ray. In other words we'd be reporting on pathology, we'd be reporting up on the status of the bony tissue, anything that a normal dentist would be reporting on.

So I am saying that with radiographs we can assist the court.

Catherine Branson: Are you aware of whether there has been a formal process of justification of radiography for age assessment through dental X-rays to demonstrate the benefit that you speak of?

Dr Anthony Hill: No. I don't think there has been any formal documented process by which we go through, no.

Catherine Branson: Are you aware of any such thing Dr Onikul or Dr Hofman? No, thank you. Could you just tell me either what is the precise level of exposure to radiation for a wrist X-ray and the relevant OPG, or tell me where to find it if you don't carry it at the forefront of your mind?

Dr Ella Onikul: I actually rang a colleague. We have [unclear] and she's going to text it back so we can have the absolute correct dose. But you could find that in a radiology textbook. I don't have it. It is a low dose, as Dr Low was saying. But it is still a dose…

Catherine Branson: It's still a dose, and Dr Hill, I think higher…

Dr Ella Onikul: …and if it's unnecessary…

Catherine Branson: Yes. And Dr Hill, higher for dental than, I think, for wrist, is that right?

Dr Anthony Hill: Yes, I have put in my submission there was a chart that Dr Low referred to from the radiation exposure. It is in the back of my submission. But yes, to take an OPG they're talking about three days of background radiation. Taking other wrist X-rays it's three hours. So when you do have an OPG taken it does exposure you to an amount of radiation. What you've got to realise too, they talk about this three days radiation. What you're getting is three days radiation in one.

Catherine Branson: Dr Hill, I've received advice that ARPANSA has expressed the current view, the view that I'm about to read out. Current international best practice would require that any use of ionising radiation for the purpose of dental or wrist X-rays for age determination must be subject to a formal process of justification to demonstrate that there is a net benefit from the exposure. Do you agree that if I accept that advice I would have to conclude that dental X-rays, OPG, for the purpose of age assessment ought not, at this time in Australia, be used? But assuming if I accept their advice?

Dr Anthony Hill: No, I do not accept that answer for that at all. If the radiograph of the developing dentition is going to help the courts in assessing the age and making that determination then I believe that radiographs and the maturation of the lower H should be an essential part of any age assessment criteria.

Catherine Branson: I understand that that's your own evidence, but I just wanted to make sure that I properly understood what you said. My question is, should I accept what ARPANSA says? Do you accept that the conclusion would have to be that it's not justifiable? What ARPANSA has said is current international best practice would require that any use of ionising radiations for the purpose of dental or

wrist X-rays for age determination, must be subject to a formal process of justification to demonstrate that there is a net benefit from the exposure.

You've told me that there's been no formal process of justification, so it must follow, mustn't it, that if I accept what ARPANSA says, and I don't have to, but if I do, I would have to find, even the OPG procedure, should not at this stage be implemented in Australia?

Dr Anthony Hill: If you follow their recommendation yes, you would.

Catherine Branson: You would urge on me a different conclusion and I understand that. Yes, thank you. Before I leave that is there anything that Dr Onikul or Dr Hofman you want to say before we move on from that?

Dr Paul Hofman: My only [unclear] as we talked about before, I think dental examination may have a reduced variability but we're still looking at four years or more and I think you're still looking at - it's very difficult to define age biologically based on radiology dental or bone

Catherine Branson: Did you say 40 years or more?

Dr Paul Hofman: Four.

Catherine Branson: Oh four.

Dr Paul Hofman: Sorry, New Zealand accent.

Catherine Branson: Four, thank you very much. I'd like also just to use the benefit I have of having you here to ask you a little bit about informed consent so far as medical practice is concerned. You do have in the back of your volumes an extract from the Australian *Crimes Act*, something I suspect you don't look at very often. But if you look at page 121 of the volume, it's almost the last page but a few, you will see a section that's unhelpfully perhaps, numbered 3ZQC. Do you see the section? Obtaining of consent for the carrying out of a prescribed procedure.

Now as I think you all know, there's only one procedure currently prescribed under this act for the purpose that we're considering and that's a wrist X-ray. But we see set out in this section, what is to be done by an investigating official who I think might fairly be said will normally be an officer of the Australian Federal Police, before seeking the consents which are required to be obtained, first from the person in respect of whom is sought to carry out the procedure that's the subject of the X-ray and then some parent or guardian or other suitable person.

I would just ask you to read what's there at subsection two. Before seeking the consents referred to in subsection one an investigating official must first inform each of the persons from whom such the consent is being sought, in a language which they're likely to understand. A number of things listed from A to H. Would you mind just reading those to yourself?

Now I've compared, for my own purposes, that list of things that are required to be told to both the subject of the X-ray and the person who is there to protect their interests. I have generally compared them with the guidelines published by the NHMRC, general guidelines for medical practitioners on providing information to patients. Since there are only three of you I might hand that document over.

I've marked the section about information. I'm going to seek your opinion, ultimately, on whether compliance with the act - how that compares with what a medical practitioner would ordinarily think is appropriate to tell someone on whom they were proposing to conduct a wrist X-ray?

Who would like to start? Yes, thank you Dr Onikul.

Dr Ella Onikul: The matter of consent is very important in the radiology department because we are a service department. In other words, the request form comes from other doctors and other doctors have requested a radiographic report. So we, at the children's hospital, go through a procedure where the radiographer asks the parent the right name, the right - do you know what we're doing.

So we do go through a form of the explanation, which is set down by what is written in this *Crimes Act*. Do we actually go through all the possible risks, in terms of radiation - well if the parent asks us is there any risk, the risk is minimal. But the real difference is the reason that the child is having the X-ray is that there is a definite clinical reason. It is not to assess the possibility of the age of the child. It's different.

Dr Paul Hofman: [Inaudible]

Dr Ella Onikul: Yes, which is different to what this is.

Catherine Branson: Dr Hofman?

Dr Paul Hofman: The only thing I can see looking at this - and I presume it's for this generic, is where they state that the information obtained from carrying out the procedure could affect the manner of dealing with that person. I don't know whether that's generic and that's what you'd say whether you actually fully explain it, because I think if you were in a research situation or a clinical situation, you'd be telling

them that this bone age could mean what it means and how does it impact, as opposed to saying it could change how we see you. I'm not sure whether that's just a generic statement of how they'd explained or whether they'd actually fully explained why they're having the procedure done, which I think is very important, as a medical person. [Inaudible]

Catherine Branson: Thank you. Dr Hill?

Dr Anthony Hill: Oh I agree entirely with what Dr Hofman is saying. As a practising dentist we have guidelines as far as informed consent, which we have to process, which we have to abide by. One of that is the benefit of the treatment that I am offering you. If we don't explain that then the consent is not informed consent. Again, the outcomes of what we do and in particular when we look in relationship to taking radiographs, the benefit to that client must be explained fully and it must also be explained the consequences of what our findings are.

Dr Paul Hofman: They must have, of course, both the client or their representatives, a full written report upon our findings, in a Medico Legal report.

Catherine Branson: I assume that - but please let me know if I'm not right - that each of you supports the appropriateness of the general guidelines published by the NHMRC. One aspect of the information that the guidelines suggest would be provided to the patient is advice as to whether the intervention is conventional or experimental.

It caught my attention in this context because of the difference of opinions in the expert group we've had here today, about whether useful information is being obtained from a wrist X-ray. In ordinary terms, if you had a medical practitioner-patient relationship and you were proposing to administer a wrist X-ray for age determination purposes, would you regard it as appropriate, or indeed necessary, to say we're going to take a wrist X-ray, expert opinion varies on whether or not it's useful for the purpose for which we propose to use it and if it is useful it will only estimate your age between a given range of years and you should be alert to the fact the outcomes of this may be used in a criminal proceeding.

What do you think about that Dr Hofman?

Dr Paul Hofman: I think it's an interesting point. When I read your findings for the research, ‘experimental’ suggests that it's experimental rather than an established technique. Now this is an established technique, we just don't accept that it's a particularly good technique. I guess that's the difference I would see with what they were saying there.

Dr. Paul Hofman: Yes, I hate to say it but there are quite a few times in medicine where you see requests for radiology, or for other things, and I'm sure you'd agree, which you would say well this test is going to provide very little clinical…

Catherine Branson: [Inaudible]

Dr Paul Hofman: Yes, exactly. So the problem you have of course is on a day to day basis you unfortunately get people who request tests which are probably inappropriate. In this context I'd agree - and I think when it comes to describing the test, I think it's very justifiable to make that point, but I would hope that that point would be made in the court of law. If they were asked this test, that they would appreciate it.

Catherine Branson: So if the intervention, as you say, in the language of this guideline is conventional rather than experimental, would that just throw out the significance of another of the topics of information, which is a degree of uncertainty of any diagnosis arrived at?

Dr Paul Hofman: Yes.

Catherine Branson: Do you agree with that Dr Onikul, and Dr Hill the same? So does it follow, from that, that the section 37QC requirements of subsection two, if you would like to look at them again, appear not to cover that issue which is - the difference of expert opinion about whether useful information is obtained and whether it is, how wide the range of confidence is with respect of that information?

Dr Paul Hofman: The only problem I see with that is if you dissuade someone from having the only test that is legally available that could prove they're a child and they decline that, then they may have no way of being proven they're a child. So the court would be between a very sharp rock and a hard place, I'd have thought.

Catherine Branson: Isn't the very purpose of informed consent, Dr Hofman, to allow them to make that choice, with appropriate information?

Dr Paul Hofman: Certainly. You have to make that point clear, as [unclear] there would be no way to prove their case. So I'm not sure you're actually helping them…

Catherine Branson: Well, there may or may not be, I suppose.

Dr Paul Hofman: Under the current system, current situation. I agree with any informed consent you need to. That to my mind could come under number D but you could expand on that. You're actually trying to say why you're doing this test and what its relevance is and how good that test is. That to my mind is all about the informed consent and D, although it's not expressed here particularly well I don't think, it's a more generic statement.

Catherine Branson: Yes, I mean it's likely that if the investigating official is the investigating Australian Federal Police officer, he or she might well know what other information is available, but even he or she may not know what information's in the hands of the lawyer representing the subject of the X-ray, I suppose. But most medical practitioners wouldn't be expected to know what other evidence is available to a court, would they. But you would expect, as I understand it, for the subject of the potential X-ray being obtained for the purpose of age assessment, to be told how reliable any information derived from the wrist X-ray would be regarded as being. Are you all agreed about that?

Dr Paul Hofman: Yes, I agree with that.

Dr Anthony Hill: Following on from Dr Hofman's point, I don't think that it should be thrown into section D there. It should be a separate item so that they are fully appraised of if you do not have this procedure then the options that we have are going to be very limited. I think that should be really pointed out.

Catherine Branson: Thank you. Just another matter that flows from this provision of the *Crimes Act*. You'll see that two consents are required, one from the subject of the X-ray and another from a parent or guardian. Or if a parent or guardian is not available, or is not acceptable to the subject of the X-ray, an independent adult person, capable of representing the interests of the person, who is acceptable. In medical practice generally, is there a view about, or any guidelines, on who constitutes an appropriate stand in for a parent or guardian if for any reason you can't get to the parent or guardian? With someone who may be a child but you don't know one way or the other?

Dr Ella Onikul: If the child is being foster cared or is a ward of the state, then we have to go [inaudible] and apart from that is has to be the legal guardian. It can't just be anybody who happens to be with the child on that day.

Catherine Branson: Legally?

Dr Ella Onikul: We can't get consent from whoever happens to be with the child on that day.

Catherine Branson: What, as you understand it, Dr Onikul, is the purpose of getting the consent from a parent or guardian?

Dr Ella Onikul: The purpose is that the parents are aware of what exactly is the purpose of the test that we're doing for the child, so that they are informed. A lot of people come to the hospital and they don't really know why the child, for instance, is having a CT scan of their abdomen or whatever. So we explain to them what

the procedure is about, exactly as that says, what we hope to get out of it and that there is a benefit to the child in us doing the test.

Catherine Branson: Yes, that for the purpose of allowing them to make a judgement as to what in their view is best for the child in question and to say yes or no to the procedure being conducted?

Dr Ella Onikul: They are allowed to say yes or no and some parents will say no and we don't do it. We try to get the clinician involved to explain why we think the test is necessary. So just goes to further explanation. But it is the right of the guardian and these days everybody looks everything up on the net so the parents are very well informed. They will ask us does the child have X, Y, Z and we think he's got Z because of this. So it's basically so that it is informed consent.

Dr Paul Hofman: It's obviously to protect the rights of the child too - and we're assuming everybody has this with the child, so it has to go through a parent or a legal guardian so you can actually make sure that I mean obviously for any teenager you'd also explain these to a teenager. If the child disagreed with the parent or the guardian, then we would have to work that out before going forward to a new test and so on.

Catherine Branson: It may be that I will conclude that for these Indonesian individuals, about whom it's uncertain whether they're adults or children, that if they are in fact children, they have no Australian guardian at all. Is there anything you'd like to say about that in the context of a medical procedure of this kind?

Dr Ella Onikul: That's a legal issue.

Dr Paul Hofman: I think it puts them in a pretty vulnerable position and they're in a different culture, different language. Obviously whoever is deemed a suitable guardian, it's going to be appointed by the court, presumably from some Indonesian friendly society. But nevertheless, it will be someone who really doesn't know them and I think it becomes much harder ethically in that situation to know what’s going on.

Catherine Branson: We're talking about whether something's ethical or not and dealing with treatment of people who may be children, although we don't know for sure that they are. Do you see, if I could put it this way, as there being some necessity from the perspective of sound medical practice, to ensure that there is an engaged adult of some kind, who can bring a judgement to bear independently of the child, should they be a child, with respect to a medical practice procedure? All three of you agree with that? Yes, thank you.

Is there anything you'd like to raise about the ethical aspects of the use of radiation for age determination processes that I haven't raised with you that you'd like to mention?

Dr Ella Onikul: I think you've covered all the aspects. It's very difficult to determine whether it is an appropriate thing to do or not because there is no definite answer and we will not be able to give you a definite answer in terms of the chronological age. It will be a range. It's easy when the child is young, for instance a 14, 15 year old. Everybody can see. But whether the child is 16 or whether he's 18 it can have a lot of problem.

Catherine Branson: I probably should have asked you this earlier, but do you know whether any wrist X-rays for age determination purposes have been taken at the Westmead Children's Hospital?

Dr Ella Onikul: Yes. They got in touch with me a couple of years about…

Catherine Branson: Sorry, 'they' being?

Dr Ella Onikul: They being - I should've looked at that. Somebody trying to work out whether a person is a child or an adult. In other words they were looking…

Catherine Branson: Someone representing the Australian Government?

Dr Ella Onikul: Yes, to see whether we could determine the bone age. I went through all this saying that we can do a bone age but it will not give you a definite age, it will give you a range.

Catherine Branson: Was that written advice or oral advice that you provided?

Dr Ella Onikul: Oral.

Catherine Branson: Over the phone? Yes, and you don't remember now to whom you gave it or the agency that they represented?

Dr Ella Onikul: No.

Catherine Branson: Thank you. That's very helpful information; it's not actually an answer to my question. Do you know if any of the wrist X-rays have nonetheless been done at the Westmead Children's Hospital?

Dr Ella Onikul: I think several have been done. I can't give you the definite numbers.

Catherine Branson: You think they have been?

Dr Ella Onikul: Yes.

Catherine Branson: Thank you. Do you know if they have been, whether the issue of consent to them has been independently attended to by whoever did it or whether the consent obtained under the act was relied on?

Dr Ella Onikul: I don't know.

Catherine Branson: You don't know, thank you. Dr Hofman was there something else that you're wanting to say? You look as though you might have been about to speak.

Dr Paul Hofman: No, I was just thinking along the lines - I've been asked similarly, for criminal reasons, to give opinion on peoples age, and I've declined on the basis that I don't believe there's any biological estimate that you can define 17 or 19 or - how can we cut off at 18. That has happened on two or three occasions by defence. So it has been defence attorneys looking at it for individuals. Yes, I've said there's just no way that you can make that decision.

Catherine Branson: Have you ever been asked your opinion on this question by any Australian authority?

Dr Paul Hofman: No, not before.

Catherine Branson: Have you been asked Dr Hill, by any Australian authority?

Dr Anthony Hill: Yes, by the Department of Human Services Victoria, to assess two Burmese legal refugees, but these were young children. When I say young children these were children - one was 12 and one was seven. A simple examination of their teeth and looking and counting their teeth, but we also did take radiographs, OPGs of these children, which was - I mean at 12 you're totally different from a child of seven. So it was not a difficult case to do.

Catherine Branson: You've not been asked whether you would intervene in the case of a particular Indonesian individual to ascertain whether they were 18 or under 18?

Dr Anthony Hill: No.

Catherine Branson: No, thank you.

Dr Anthony Hill: I should state that other colleagues have. Other forensic odontologists have been asked for an opinion, yes.

Catherine Branson: Thank you. I think we've probably covered this but we've had some mention of the possibility of X-raying clavicles for age determination purposes. Is this a useful method for determining whether someone is over or under the age of 18 or was it only valuable at a higher age?

Dr Ella Onikul: We've never done it.

Dr Paul Hofman: I've never done it. My understanding is, just as you've said, is that it is actually something that's useful for older ages and certainly for forensic purposes, when people have died, to get an estimation, but to actually define 18 or less, no

Catherine Branson: There are other methods, or variations on methods, that have come out from other submissions, including that of the George Institute which I referred to before, where they spoke of ultrasounds for bone, wrists and elbows and MRIs of growth plate maturity. Do you have knowledge of these methodologies and whether they're yet, if they ever will be, at a stage of refinement that they would be useful?

Dr Ella Onikul: MRI is far more difficult to obtain. It would take quite a long time. A scan would take at least 20 minutes. There are no standards as there are with simple bone radiographs. I have read some literature on it and it could possibly in the future be a way because it deals with no ionising radiation. But the availability of an MRI unit is not the same as the availability [inaudible].

Dr Paul Hofman: So there's a link with what you've got. Irrespective of how accurate the assessment that you have, you're still going to get a five year range because of the change differences in puberty, which occur naturally. So I don't think…

Dr Ella Onikul: But there are no standards anyway.

Dr Paul Hofman: Exactly. But precision won't make any difference because normal variation means that you are going to get a proportion of 18 year olds who are younger and you're going to get a proportion of 14 year olds who are older. It's just the way it works. Unless you actually have more data it's not going to help unfortunately.

Dr Ella Onikul: The only advantage is that there's no ionising radiation.

Dr Paul Hofman: Yes.

Dr Anthony Hill: In the institute in which I work in Melbourne, every person - because we're dealing with deceased is CT-scan. From the data that we've had a look at, we've got over 25,000 individuals who have been scanned, we have been looking at the CT images of clavicles, we have been looking at the CT image of their spheno-occipital synchondrosis which is one of the bones that also has these fusion and growth plates. Again, even a brief look at the information there it is not specific and we cannot determine with any degree of accuracy at all.

Catherine Branson: So then let's turn to what may be one of the most difficult aspects of what we're thinking about and that is to explore what might be practical recommendations that can be made to Australian authorities, about how they might seek to

determine the age of young Indonesian national suspected of people smuggling.

The submissions that we have in front of us in the folder, a number of them speak of more comprehensive approaches, multifactorial approaches, holistic approaches. I'm interested in testing the practicality and I suppose what degree of increased reliability we get if we adopt these approaches for the very purpose of determining whether someone's over or under the age of 18.

Dr Hill, you're an advocate for a multifactorial approach and you've spoken about it and I've explored that a little bit already with you. Is there anything more that you think you can offer that would assist me on this topic of what is, or might be, the practical way forward?

Dr Anthony Hill: I believe that any individual who in purporting to be a child must be examined. Not just radiographed, but must be physically examined by, in my case of course, by a dental practitioner, who is trained in age assessment. Because we can glean a lot of information from full and thorough examination of what is in the oral cavity. As I said there are age changes - that relate to age changes in the gingiva in the tongue, in the palate in the bony tissue, in the teeth, in the wear facets and so on, which are all age related.

This is the multifactorial approach that I would take. I don't think that looking at psychological evidence, looking at the other parameters that they are putting forward are of much value. I think they would delay the process more in determining the age of an individual.

I believe that any person who claims to be under the age of 15 can be very simply and very quickly and very easily assessed and a report written very quickly so that this person can, if they are a child, be released from any incarceration at all. We do have difficulty when it comes to 18 years of age. I do not doubt that at all. But above 18 years of age, 30 years of age, 35 years of age, again the oral cavity - there were age changes there which practically - from a practical point of view, tell me that this person cannot possibly be 18. Again that will be challenged.

Catherine Branson: Dr Hill, you expressed a view in the course of that about the value of interview by psychologists of psychiatrist. Could I ask the basis upon which you express that opinion? That is, do you express that as an expert opinion based on some knowledge you have about the proved value of such X-rays or is that, just as it were, an instinct you have that they're not likely to be very helpful?

Dr Anthony Hill: That is referenced that this here is - there's no evidence that this here will assist in the age assessment at all.

Catherine Branson: What are you relying on, Dr Hill?

Dr Anthony Hill: There are references that I've put into my…

Catherine Branson: In your paper?

Dr Anthony Hill: Yes.

Catherine Branson: Thank you very much. Do you have any view about that, Dr Onikul?

Dr Ella Onikul: As far as radiology is concerned we cannot give a definite chronological age. The best thing that we have, and it is not accurate, is the radiograph…

Catherine Branson: Wrist X-ray?

Dr Ella Onikul: The wrist X-ray. But that has variation. It will always be imprecise. Combined with other things it can give you a range. As I said, and I think as everybody agrees, if it's definitely the - the wrist is not skeletally mature then it's likely that the patient is younger than 18. But even that is not completely definite.

Catherine Branson: You college has spoken out against the use of wrist X-rays and that appears at page 52 of the papers. That's a view that you share?

Dr Ella Onikul: Yes. I mean I don't think that we can categorically say the age of the child and with the ALARA principle, just to do an X-ray with the possibility isn't justified and it is not an accurate, definite result. It's not.

Catherine Branson: Your area of expertise being radiology, you say there's nothing that you believe radiologists can offer that's helpful in this area? No? Thank you. Dr Hofman?

Dr Paul Hofman: Firstly Dr Hill's comments I think are interesting in terms of potential of looking in a more holistic way at the oral cavity. I don't think the data is there, quantitative data, to demonstrate that that works currently, but it makes an awful lot of sense on a first principles basis. I think before we use it though we would need to have more data and we'd have to have some way of collaborating - there has to be a group, an adolescent youth group what have been assessed and they had quantitative ways of assessing this. But at long term I think that's certainly a potential way forward.

Can I propose a slightly different approach - this comes from the camp of psychological interviewing and psychological testing. The law's looking at an age of 18. I accept chronological age of 18 is a very important concept, you've got to define childhood, but in reality childhood is a psychological age. Does it really matter if you're psychologically a 16 or 15 or 14 year old when you're 19?

Surely it matters, in terms of being imprisoned, how you're going to respond. So to my mind if you do psychological testing and that's saying you are immature, to my mind that's equally as relevant as if you've got a bone age of 18.

That would be my approach - it's not the legal approach, but on an ethical and a humane approach, I think that psychological testing may well be a better way forward because it really will tell us how fit these people are to have done what they've done. Have they perceived what they've done, are they able to understand the consequences. But that gets away from the whole biological component.

Catherine Branson: I've just confirmed that there's nothing else that I can think of that I should ask you about this morning. Is there anything that I haven't asked any of you that you think it would be important for me to know as I go into this inquiry?

Dr Anthony Hill: We've covered a wide range of issues here. I think we've covered issues that Australia is going to have to face, because this problem is not going to go away. In fact it's going to expand and as I say, other ageing issues of women who are trafficked, ageing issues of marriage and so on. So I think if we can get some processes and protocols in place now we will be better prepared and better readied for any future problems that we have.

Catherine Branson: Well then, could I thank the three of you very much. I have already thanked the two that have left. But I am enormously appreciative of you giving up your valuable time, both to prepare for this hearing today, in doing submissions, preparing for me to ask you questions today and in being here giving the answers. I've been greatly assisted by what you've all had to say.

It's a difficult issue that I have to grapple with, so you can understand I'm looking for the highest level of expert help that I can find anywhere in the world. I'm enormously pleased to have the assistance of the three of you, the submissions of your organisation and the submissions of the other experts who put material to us. So thank you very much.

I'd also want to thank the Federal Court. I'm not sure if any of them can hear but I want to thank the Federal Court for allowing us to use their facilities and particularly the video link facilities and the room. The staff at the Federal Court have been enormously helpful and I'm very grateful to them and the staff of the Australian Human Rights Commission have also put a lot of effort into preparing for today and I thank all of them as well.

So thank you all very much and that closes today's hearing.

[END OF TRANSCRIPT]