Women's experiences of commercial three-dimensional ultrasound scans

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Introduction

Ultrasound has become a routine part of UK maternity care and has a range of diagnostic and screening purposes. The last two decades have seen the development of three-dimensional (3D) scans, which use computer software to produce a seemingly 3D image of the foetus (Rankin *et al* 1993). Four-dimensional (4D) scans include the dimension of time, i.e. moving images of the foetus. This technology does currently have limited diagnostic use (Campbell 2002, Kurjak *et al* 2007) though it can be helpful in screening for facial anomalies.

Over the last two decades 3D and 4D scans have become available to expectant parents (Roberts 2012) through commercial screening companies. They are generally marketed as 'bonding scans' or 'reassurance scans' (Wadephul 2013), in line with claims that the more 'baby-like' images enhance the parental relationship with the foetus and provide reassurance to expectant parents (Campbell 2002). This is not supported by research into the psychological impact of 3D and 4D scans, which suggests that while these scans may enhance parental recognition of the foetus , they do not increase 'bonding' or reassurance compared to conventional two-dimensional (2D) scans (Righetti *et al* 2005, Rustico *et al* 2005, Leung *et al* 2006, Sedgmen *et al* 2006, Lapaire *et al* 2007, de Jong-Pleij *et al* 2013). These studies offered 3D/4D scans as part of their research, rather than exploring women's experiences of scans they had actively sought out and paid for. The case studies presented in this paper are part of a larger PhD study exploring discourses of 3D/4D scans and women's experiences of having these scans (Wadephul 2013). The case studies aim to explore why individual women choose commercial 3D/4D scans, what their expectations and experiences are and how the scans affect their psychological experience and their maternal-foetal relationship.

Methods

Study design

Case studies make use of different methods, rather than being a method in themselves. They are ideographic in nature and do not aim for generalisations, instead providing, '*a rich picture with many kinds of insights coming from different angles, from different kinds of information*' (Thomas 2011:21). The case studies used longitudinal qualitative and quantitative data which

were collected before and after 3D/4D scans in the form of interviews, questionnaires and research notes. The quantitative data allowed a detailed look at the psychological effects of 3D/4D scans on individual women, while the qualitative data offered further depth and context to the experience of each woman. This made it possible to construct a detailed narrative for individual women. This approach does not provide generalisable findings regarding the psychological effects of 3D/4D scans, but offers an exploration of individual experiences and the impact of the scan on each woman, which may suggest some directions in future research and the development of a theoretical framework.

Ethical approval

Ethical approval was granted by the Research Ethics Committee of the Faculty of Health and Social Care at the University of Hull.

Participants

The women who took part were a self-selected sample recruited through online parenting forums, notices on the websites of two scanning companies and word-of-mouth. To take part women needed to be pregnant, over 18 and planning to have a 3D/4D scan. Six women were included in these case studies.

Data collection

Time points

Interview and questionnaire data were collected at three time points: shortly before the scan, soon after the scan and several weeks later in late pregnancy. These time points were chosen in order to enable exploration of how women's views, psychological status and experiences changed in relation to the 3D/4D scan. At the first time point participants were between 25 and 30 weeks' pregnant.

Interviews

Semi-structured interviews were carried out face-to-face or over the phone. The interviews at time points 1 and 3 were in-depth and lasted between 45 and 90 minutes; the interview at time point 2 was a brief telephone interview focusing on the experience of the scan. Interviews were guided by a flexible schedule which allowed the interviewer to follow up

issues and individual experiences brought up by the women. All interviews were audio-recorded and transcribed verbatim.

Questionnaires

The questionnaires collected demographic details and information about the women's current and, where applicable, past pregnancies. They also contained questions about women's expectations, reasons and experiences relating to 3D/4D scans, as well as psychological instruments assessing attitude to pregnancy (adjective scale), based on Green *et al* (1998) and Jomeen (2006), the maternal-foetal relationship (bonding), the Prenatal Attachment Inventory (PAI) (Müller 1993), and anxiety and depression, the Hospital Anxiety and Depression Scale (HADS) (Zigmond & Snaith 1983).

Research notes

Notes taken at the time of collecting interviews and questionnaires included thoughts on the women's mood, non-verbal communication and body language, as well as additional information provided by the women. While these notes did not contribute to the case studies to the same extent as the interviews and questionnaires, they nonetheless added depth and context to the narratives.

Analysis

Quantitative findings were analysed descriptively for each woman and across the women. The interviews were analysed separately using interpretative phenomenological analysis (Wadephul 2013); findings from the interviews used in these case studies were based on this analysis. Results were collated as individual narratives for each woman, with a focus on reasons, expectations and experiences of the scans and their psychological impact on the women and how they related to the foetus . In this paper they will be presented as summaries for each of these themes. All names used here are pseudonyms.

Findings

Women's backgrounds

There was some variation in socio-economic background, but none of the women came from deprived backgrounds and all had grown up in the UK. Their family context varied: three were expecting their first child (Isabel, Nikki, Jane), two had an older child of toddler age

(Naomi, Claire) and one (Sarah) had two teenage children. With one exception they had all planned the pregnancy, though for some it happened sooner than expected. Sarah had been told after the birth of her last child that she would not be able to have more children and only found out about the pregnancy at 12 weeks' gestation, when she was mistakenly diagnosed as having an ectopic pregnancy.

3D/4D scan: reasons, expectations and experiences

For those women who had had a 3D/4D scan in a previous pregnancy (Naomi and Claire) the main reason for having a scan in their current pregnancy was wanting to treat both children the same; considering the images a 'keepsake' for the children played an important role in their decision. Naomi and Claire seemed less excited or emotional about the scan, possibly because it was not a new experience for them. Those who had not had a scan previously put more emphasis on 'meeting' and seeing the foetus and showed more curiosity about what he/she would look like. For them, the scan was an exciting experience and a unique opportunity to get to know the foetus better. The reasons most frequently given were 'meeting the baby', 'curiosity' and 'finding out more about the baby'.

Although the diagnostic use of commercial 3D/4D scans is limited (Campbell 2002, Kurjak *et al* 2007), several women saw the scan as an opportunity for reassurance about foetal well-being. Nikki, for example, was particularly anxious about foetal health and seemed to gain a degree of reassurance from the scan. She gave 'making sure the baby is ok' as the most important reason for having a 3D/4D scan. Jane appreciated the detailed growth report which she received with her scan — not something all commercial scanning companies offer.

The expectations women had of the 3D/4D scan were less diverse than the reasons for having it: all expected clear, detailed images of the baby, particularly the face, enabling them to see 'what the baby looks like'. Some women also hoped to see 'what the baby got up to' in the womb, ie linking the scan to foetal activity. Expectations of a clear, good image are likely to be a reflection of the scanning companies' marketing material, particularly websites, which present 3D/4D scans as providing a clear image of the foetus , a possibility of really being able to see what he/she looks like before birth.

Experiences of the 3D/4D scan and of what could be seen of the foetus varied. Sarah was very enthusiastic and very happy with the experience: '*the detail, it was fantastic!*' (Sarah-2). For others the experience was more mixed and most expressed some disappointment at not being able to see the foetus as clearly as expected. Nikki was very disappointed at not being able to obtain a good image despite having a re-scan; this was likely to be due to the position of the foetus and because at 30 weeks she had had the scan relatively late.

Impact of the 3D/4D scan on women's psychological experience

Two of the women, Isabel and Claire, had noticeably lower anxiety scores on the HADS after the scan. Both were concerned about specific health problems and it is possible that they were reassured by the 3D/4D scan. Isabel, for example, had been told at an earlier routine scan that her placenta was low-lying, which she was concerned about; the 3D/4D scan confirmed that this was not the case anymore. Her scores for the HADS items '*I get a sort of frightened feeling as if something awful is going to happen*' and '*Worrying thoughts go through my mind*' were lower after the scan. However, it is impossible to say with certainty whether this was due to the 3D/4D scan.

It is difficult to say if women's responses to the adjective scale were affected by the scan. Nikki and Naomi, for example, chose 'protective' and 'confident' respectively after, but not before, the 3D/4D scan. This may be related to having seen the foetus and possibly having gained some reassurance, but is not conclusive evidence. In the interviews, Sarah appeared to feel considerably more positive about the pregnancy and less anxious after the scan; her very positive experience of the scan seemed to affect her attitude to the pregnancy and her psychological status.

Impact of the 3D/4D scan on how women relate to the foetus

Sarah's PAI (bonding) scores increased considerably after the scan; this was reflected in the interviews, in which the way she talked about the foetus had changed dramatically. Whereas before the scan she had found it very difficult to think about and imagine the baby and seemed to find it difficult to accept the pregnancy, the 3D/4D scan appeared to enable her to form an image of the foetus and make the foetus more 'real': '*it was so real to me and up to then it wasn't*' (Sarah-2); '*you could see … it's an actual baby*' (Sarah-2). Isabel and Jane

said that after the 3D/4D scan '*I have that kind of image in my head of her*' (Isabel-3) and '*I have now got that picture in my head*' (Jane-2).

Discussion

Women's reasons for having a 3/4D scan varied to some extent, but for most curiosity and wanting to see and 'meet the baby' were most important. While this can also be the case for routine 2D scans, it is more pronounced with 3D/4D scans, largely due to the quality of the image which promises to give expectant parents a glimpse of what their baby may look like. There is some evidence that these scans make it easier for expectant parents to recognise aspects of foetal anatomy (Leung *et* al 2006, Lapaire *et* al 2007, Pretorius *et al* 2007, Edwards *et al* 2010); however, this clearly depends on whether good-quality images can be obtained. It is interesting that despite the strong emphasis on scanning websites of the role of 3D/4D scans in enhancing 'bonding', none of the women explicitly name this as a reason for having the scan. The desire of some women to gain reassurance from the 3D/4D scan illustrates the blurred boundaries between the social and medical aspects of commercial 3D/4D scans: they are not done explicitly for clinical reasons and many scanning companies state that they do not have a medical purpose and do not replace routine scans (Wadephul 2013). However, they also still retain medical connotations and the potential to provide reassurance, at least in the minds of those who choose to have them.

What is strikingly different to women's expectations and experiences of routine 2D scans is the importance of clarity and detail, particularly of the face. Women's expectations of what they would see were high and most said that they expected to see 'what the baby looks like'. These expectations are reflected on the websites of scanning companies, which suggest that images will be clear and detailed and thus enable prospective parents to 'meet their baby' (Wadephul 2013). Many websites have sections comparing scan images with images of babies after they were born, highlighting the similarity between pre- and post-birth images. These high expectations can easily be disappointed; of all the women in this study only one (Sarah) was very happy with the quality of the images. Others expressed some disappointment and Nikki was unable to obtain any good images. In line with these findings, Ji *et al* (2005) have also found that suboptimal 3D/4D images could lead to disappointment as maternal expectations have been so high. In the case of commercial 3D/4D scans this disappointment may be exacerbated as women have had to pay for the scan.

While these case studies do not support evidence that 3D/4D scans reduce anxiety or provide reassurance, it is conceivable that for some women with specific concerns about foetal health a 3D/4D scan may give reassurance. This is likely not to be due to the 3D nature of the image, but because professionals are able to provide reassurance about specific concerns. Leung *et al* (2006) found no evidence that 3D/4D scans were superior to 2D scans in terms of reducing anxiety in pregnant women who had an increased risk of having a foetus with abnormalities. However, 80% of the women said that they had a better understanding that their foetus did not have an abnormality after seeing 3D/4D rather than 2D images, possibly due to the clearer images. It is possible that while 3D/4D scans do not appear to reduce anxiety to a clinically significant degree, they may nevertheless provide reassurance for some women. This reassurance may be due to the presence of professionals as well as the quality of the 3D/4D image which makes it easier to visualise the foetus . However, as Gorincour *et al* (2006) point out, '*future parents must be fully informed that a 4D videotape of their beautiful foetus cannot rule out a severe malformation*' — as 3D/4D scans do not explicitly check for anomalies it is possible that these may be missed or disregarded (Wax & Pinette 2006).

Maternal-foetal relationships are complex (Walsh *et al* 2013) and difficult to conceptualise and measure; they are frequently referred to as 'bonding' or 'attachment', though these terms are not necessarily appropriate (Walsh 2010, Redshaw & Martin 2013). It is often assumed that ultrasound scans in general have a positive impact on this relationship, although the evidence for this is ambiguous. It has also been suggested that 3D/4D scans have a greater impact on 'bonding' in pregnancy than 2D scans (Campbell 2002, Campbell 2006) and are generally marketed as 'bonding scans' (Wadephul 2013). However, the available evidence so far does not support this (Righetti *et al* 2005, Rustico *et al* 2005, Sedgmen *et al* 2006, Lapaire *et al* 2007). While the case studies do not support these claims either, they suggest that the scans may, for some women, have aided some components of the maternal-foetal relationship, such as being able to form a clearer image of the baby and making the baby more real. For Sarah in particular the scan seemed to have made a difference in how she relates to and thinks about the foetus . Nevertheless, it is not clear what the long-term implications are and whether it will make a significant difference in how women think about and relate to the foetus during pregnancy or affect postnatal bonding.

Conclusion and implications

The case studies illustrate the diversity, even within a small sample, and the importance of considering each woman's experiences, needs and choices on an individual basis. This research does not support claims that 3D/4D scans increase 'bonding' or reduce anxiety, but provides some evidence that for some women these scans may offer a degree of reassurance and/or have a positive influence on some components of the maternal-foetal relationship. Women's experiences of the scans have, on the whole, been positive, but there was also a considerable amount of disappointment with the quality of images.

The scans, offered privately, could be seen as part of the commercialisation of health care in general and pregnancy in particular. The scan does not just provide the images but also additional contact with a professional, which seemed important to some of the women in this study. In this context, a private scan offers an additional opportunity to meet a professional. This may be particularly the case for multiparous women who are usually seen even less frequently. In the interviews, Sarah commented on not seeing health professionals very frequently, especially as she already had children; she talked at some length about this and it seemed that she felt a little 'abandoned'. Commercially available 3D/4D scans may therefore play a role in filling a vacuum left by a reduction in the number of antenatal contacts with health professionals. A reduced number of appointments is likely to lead to women seeking more 'care' elsewhere; this may include non-NHS antenatal courses, pregnancy yoga and similar classes, but also private scans and the purchase of hand-held doppler devices (Chakladar & Adams 2009). This may have wider implications for policy development.

The scans are not offered within the NHS and it may therefore seem that they are of little relevance to health professionals working within the NHS. However, pregnant women may well discuss attending a 3D/4D scan with their midwife, so an awareness of issues concerning these scans is therefore important. Expectations of what the scan will be able to show may be very high, which may lead to disappointment. Another consideration is that while a 3D/4D scan may provide reassurance, it is not primarily a diagnostic tool and problems may be missed; parents may find this particularly hard to deal with. Furthermore, some women may seek out 3D/4D scans if concerns have been raised during antenatal appointments or routine scans and further NHS scans are not immediately available; and with added pressures on resources this is may be increasingly the case. It is also possible that women who decide to have a 3D/4D scan may have underlying reasons for doing so; these may include increased

anxiety, either generally or about specific issues, or, as in the case of Sarah, difficulties in relating to the foetus . In these cases the woman's decision to have a scan may offer an opportunity for midwives to explore possible underlying issues.

There has been debate in the medical and professional community about commercial, so-called 'boutique', clinics which offer scans without clear medical indications or referral from a health professional. Many professional organisations have spoken out against the use of ultrasound without clear clinical indications (Rados 2004, International Society of Ultrasound in Obstetrics and Gynecology (ISUOG) 2009) and there are ethical issues around the use of a medical technology (which may have a harmful impact) for 'entertainment' (Chervenak & McCullough 2005, Voelker 2005, Gorincour *et al* 2006, Wax & Pinette 2006).

Midwives working within the NHS are not in a position to recommend 3D/4D scans and there is no firm evidence of their psychological benefits or otherwise. However, there is currently no conclusive evidence that the scans are harmful either, though concerns remain over safety. Some women will choose to have a 3D/4D scan, of which some may find them beneficial. It is therefore important for midwives to have an awareness of issues around these scans and be open to exploring the reasons for the choices women make.

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References

Campbell S (2002). 4D, or not 4D: that is the question. *Ultrasound in Obstetrics & Gynecology* 19(1):1-4.

Campbell S (2006). 4D and prenatal bonding: still more questions than answers. *Ultrasound in Obstetrics & Gynecology* 27(3):243-4.

Chakladar A, Adams H (2009). The dangers of listening to the foetal heart at home. *BMJ* 339(7730):1112-3.

Chervenak FA, McCullough LB (2005). An ethical critique of boutique foetal imaging: a case for the medicalization of foetal imaging. *American Journal of Obstetrics and Gynecology* 192(1):31-3.
de Jong-Pleij EAP, Ribbert LSM, Pistorius LR *et al* (2013). Three-dimensional ultrasound and maternal bonding, a third trimester study and a review. *Prenatal Diagnosis* 33(1):81-8.
Edwards MM, Wang F, Tejura T *et al* (2010). Maternal reactions to two-dimensional compared to three-dimensional foetal ultrasonography. *Journal of Psychosomatic Obstetrics and Gynecology* 31(2):53-9.
Gorincour G, Tassy S, LeCoz P (2006). The moving face of the foetus - the changing face of medicine. *Ultrasound in Obstetrics & Gynecology* 28(7):979-80.
Green JM, Coupland VA, Kitzinger JV (1998). *Great expectations: a prospective study of women's expectations and experiences of childbirth*. 2nd ed. Hale, Cheshire: Books for Midwives Press.
International Society of Ultrasound in Obstetrics and Gynecology (2009). ISUOG statement on the non-medical use of ultrasound, 2009. *Ultrasound in Obstetrics & Gynecology* 33(5):617.
Ji EK, Pretorius DH, Newton R *et al* (2005). Effects of ultrasound on maternal-foetal bonding: a comparison of two- and three-dimensional imaging. *Ultrasound in Obstetrics & Gynecology* 25(5):473-7.
Jomeen J (2006). *Choice in childbirth: psychology, experiences and understanding*. [PhD Thesis]. Leeds: University of Leeds.
Kurjak A, Miskovic B, Andonotopo W *et al* (2007). How useful is 3D and 4D ultrasound in perinatal medicine? *Journal of Perinatal Medicine* 35(1):10-27.
Lapaire O, Alder J, Peukert R *et al* (2007). Two- versus three-dimensional ultrasound in the second and third trimester of pregnancy: impact on recognition and maternal-foetal bonding. A prospective pilot study. *Archives of Gynecology and Obstetrics* 276(5):475-9.
Leung KY, Ngai CSW, Lee A *et al* (2006). The effects on maternal anxiety of two-dimensional versus two- plus three-/four-dimensional ultrasound in pregnancies at risk of foetal abnormalities: a randomized study. *Ultrasound in Obstetrics & Gynecology* 28(3):249-54.
Müller ME (1993). Development of the Prenatal Attachment Inventory. *Western Journal of Nursing Research* 15(2):199-215.

Pretorius DH, Hearon HA, Hollenbach KA *et al* (2007). Parental artistic drawings of the foetus before and after 3-/4-dimensional ultrasonography. *Journal of Ultrasound in Medicine* 26(3):301-8.

Rados C (2004). FDA cautions against ultrasound 'keepsake' images. *FDA Consumer* 38(1):12-16.

Rankin RN, Fenster A, Downey DB *et al* (1993). Three-dimensional sonographic reconstruction: techniques and diagnostic applications. *American Journal of Roentgenology* 161(4):695-702.

Redshaw M, Martin C (2013). Babies, 'bonding' and ideas about parental 'attachment'. *Journal of Reproductive and Infant Psychology* 31(3):219-21.

Righetti PL, Dell'Avanzo M, Grigio M *et al* (2005). Maternal/paternal antenatal attachment and fourth-dimensional ultrasound technique: a preliminary report. *British Journal of Psychology* 96(1):129-37.

Roberts J (2012). 'Wakey wakey baby': narrating four-dimensional (4D) bonding scans. *Sociology of Health & Illness* 34(2):299-314.

Rustico MA, Mastromatteo C, Grigio M *et al* (2005). Two-dimensional vs. two- plus four-dimensional ultrasound in pregnancy and the effect on maternal emotional status: a randomized study. *Ultrasound in Obstetrics & Gynecology* 25(5):468-72.

Sedgmen B, McMahon C, Cairns D *et al* (2006). The impact of two-dimensional versus three-dimensional ultrasound exposure on maternal-foetal attachment and maternal health behavior in pregnancy. *Ultrasound in Obstetrics & Gynecology* 27(3):245-51.

Thomas G (2011). *How to do your case study. A guide for students & researchers*. London: Sage:21.

Voelker R (2005). The business of baby pictures: controversy brews over 'keepsake' foetal ultrasounds. *JAMA* 293(1):25-7.

Wadephul F (2013). *3D ultrasound in pregnancy: discourses, women's experiences and psychological understanding*. [PhD Thesis]. Hull: University of Hull.

Walsh J (2010). Definitions matter: if maternal-foetal relationships are not attachment, what are they? *Archives of Women's Mental Health* 13(5):449-51.

Walsh J, Hepper EG, Bagge SR *et al* (2013). Maternal-foetal relationships and psychological health: emerging research directions. *Journal of Reproductive and Infant Psychology* 31(5):490-9.

Wax JR, Pinette MG (2006). Nonmedical foetal ultrasound - why all the noise? *Birth* 33(1):1-3.

Zigmond AS, Snaith RP (1983). The Hospital Anxiety and Depression Scale. *Acta Psychiatrica Scandinavica* 67(6):361-70.

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